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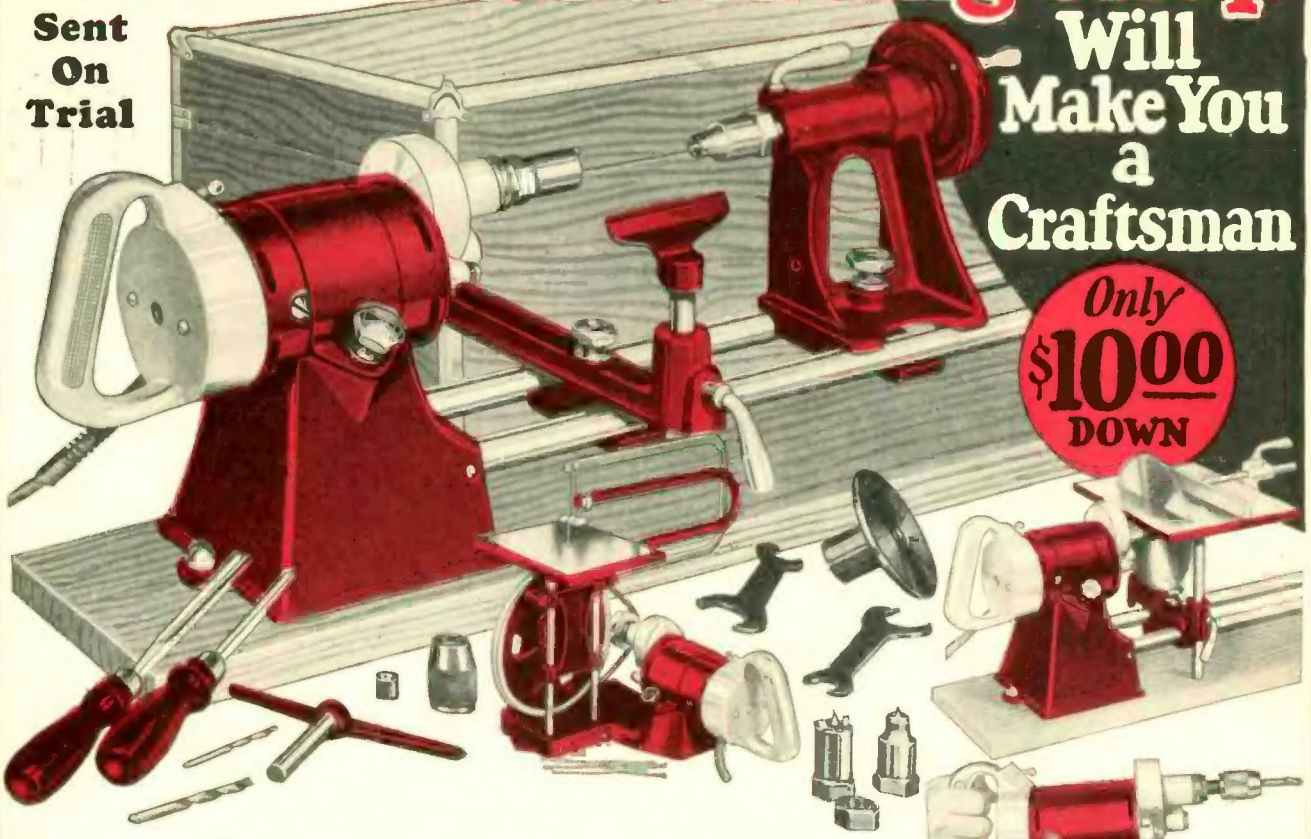

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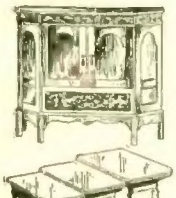

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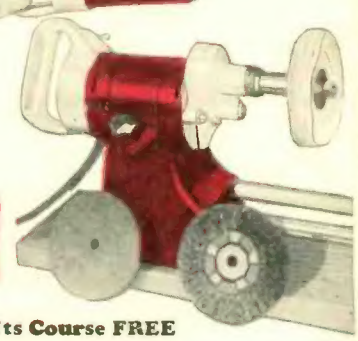

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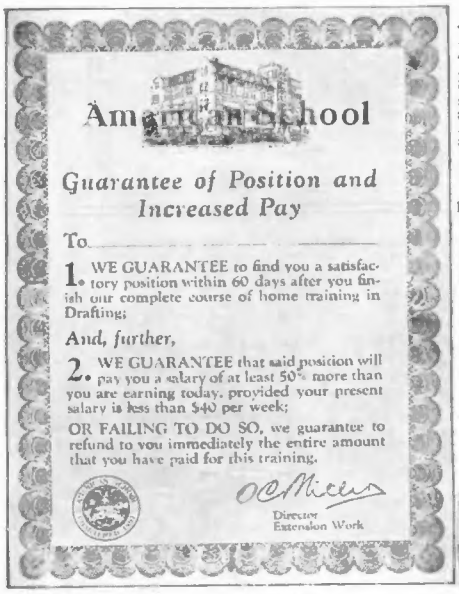

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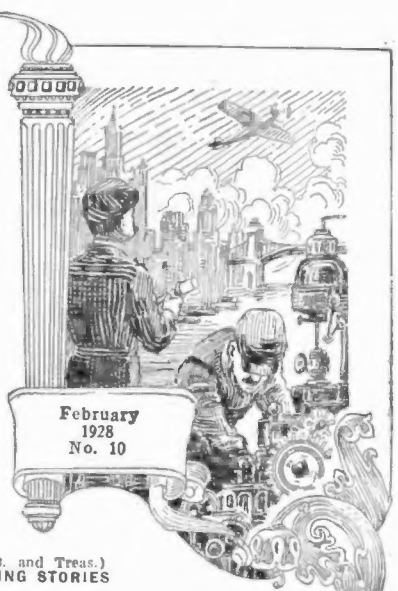

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IN MARCH ISSUE

Tail-Spin Eliminated!

It is believed that the brave fliers who lost their lives in an attempt to span the Pacific Ocean were the victims of tail-spins. This article will, therefore, be of extraordinary interest to everyone.

Hobbies of Famous Men

No matter how famous a man or woman becomes, invariably we find that they have a hobby.

Cities in Miniature

This article gives many constructional hints, and shows how marvelous miniature reproductions of buildings, trains, trees, et cetera, are built.

A New Super-Het.

New radio sets may come and go, but the super-het of efficient design still retains its prestige. The one to be described in the March number has super-selectivity and range.

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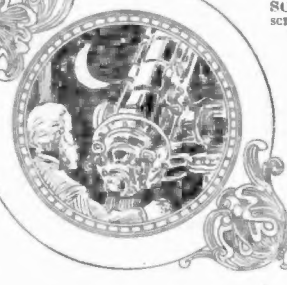

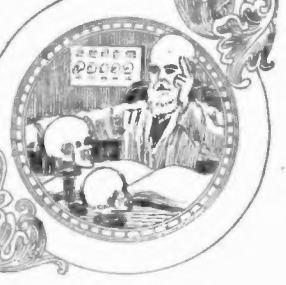

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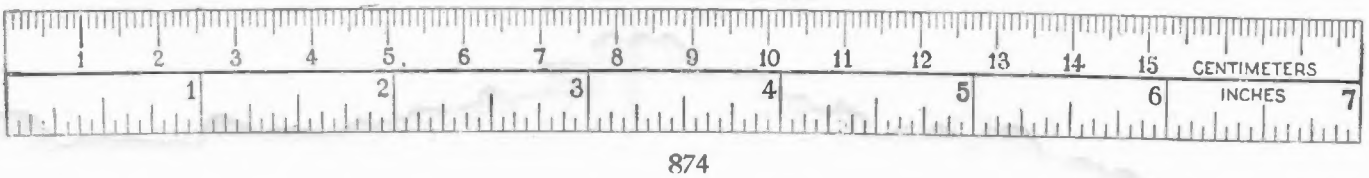

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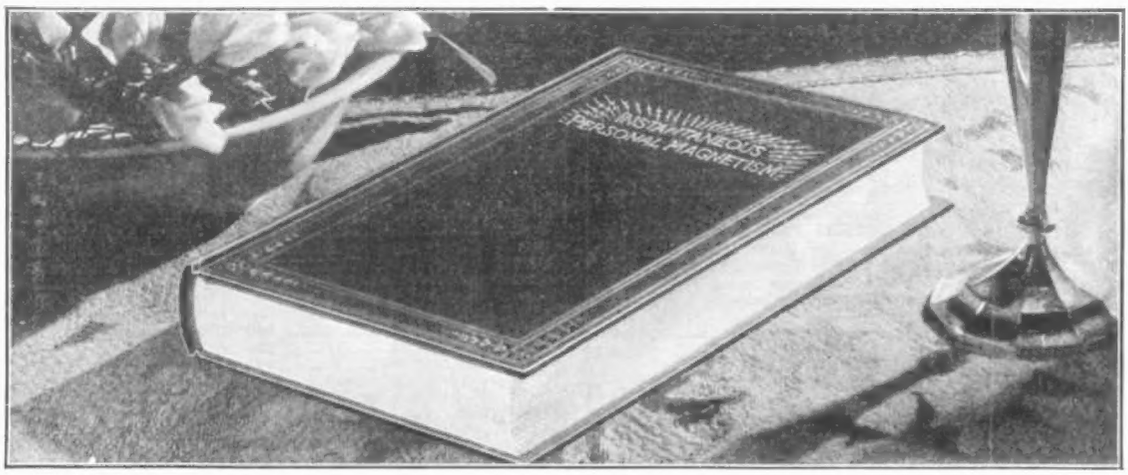

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- How to read people's thoughts by watching their eyes
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- How to use Magnetic Healing
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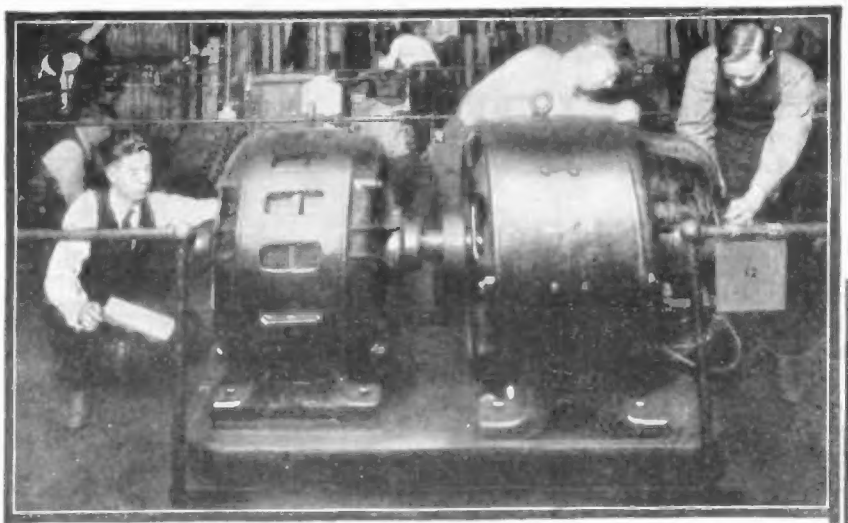
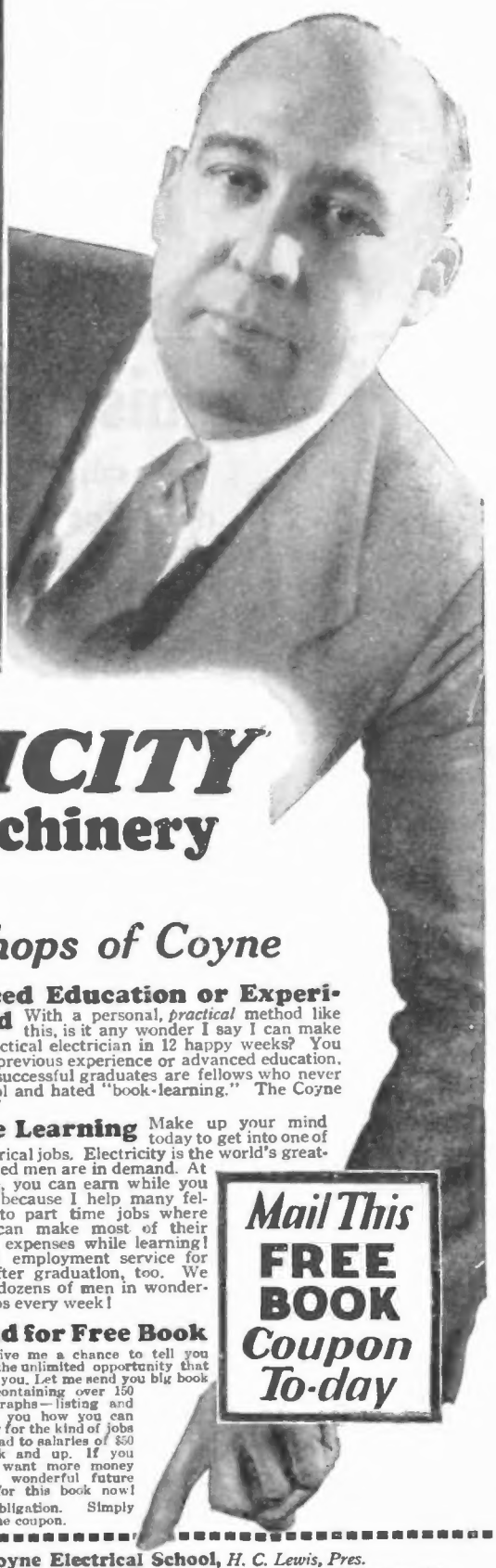


A Glimpse Into the Coyne Electrical School

Those who see the great roaring shops of Coyne for the first time are amazed. Here are students from every State in the Union working on the greatest outlay of electrical apparatus ever assembled in any school . . . costing hundreds of thousands of dollars . . . real dynamos, huge motors, actual skeleton houses, complete power plants, transmitting stations, switchboards of all kinds . . . everything from doorbells to farm power systems. Here, with this full-size machinery in full operation every day, Coyne students get years of experience in a few months. Here—and nowhere else in the world—can you get such training!

The photograph above is one of 150 views in our catalog, a copy of which will be mailed free upon request. See coupon below.



LEARN ELECTRICITY

On Actual Electrical Machinery —In 12 Weeks!

By Actual Work—in the Great Shops of Coyne

SOME kinds of jobs ought to be labeled with a big sign that says "Man-killer." They are either so heavy, dirty and hard that they sap a man's strength and keep him dog-tired all the time—or else they are so disagreeable, uninteresting and poorly paid that they kill his ambition in almost no time. And AMBITION is the most valuable thing a man can have!

Fascinating Work—Real Pay!

That's why so many men are turning to ELECTRICITY, which offers unlimited rewards and opportunities—with ordinary salaries of $50 a week and up! Right now big electrical jobs are actually going begging! Trained electrical men are in demand—and the need is growing every day! The situation is one that spells O-P-P-O-R-T-U-N-I-T-Y in letters a foot high for the man who is wide-awake enough to see it!

Learn Quickly Let me make you a practical electrician—the Coyne way. I've done it for thousands of others—farmers, laborers, factory men, and hundreds who haven't had more than 8th grade education! I can do it for you—and start you off on the road to independence and big earnings in just 90 days!

Learn by Doing The secret of Coyne-training is that it is PRACTICAL work. No unnecessary theory. In the great shops of Coyne you learn the "ins and out" of Electricity by actual work on real electrical equipment—the finest outlay in the country! And best of all—instructors work right with you every step of the way, showing you all the electrical secrets that are essential to your success.

The New $2,000,000 Coyne School

Now In Our New Home

This is our new, fireproof, modern home wherein is installed thousands of dollars worth of the newest and most modern Electrical equipment of all kinds. We now have a large amount of floor space devoted to the exclusive teaching of practical electricity. Every comfort and convenience has been arranged to make you happy and contented during your training.

No Advanced Education or Experience Needed With a personal, *practical* method like this, is it any wonder I say I can make any man into a practical electrician in 12 happy weeks? You don't need a bit of previous experience or advanced education. Many of our most successful graduates are fellows who never went to high school and hated "book-learning." The Coyne method is *different!*

Earn While Learning Make up your mind today to get into one of these real-pay electrical jobs. Electricity is the world's greatest industry. Trained men are in demand. At Coyne, you can earn while you learn because I help many fellows to part time jobs where they can make most of their living expenses while learning! FREE employment service for life after graduation, too. We place dozens of men in wonderful jobs every week!

$60 A Week Jobs

are common in electricity. Our free employment bureau puts you in touch with many openings to choose from. Our students get positions which lead to salaries of $50.00 — $60.00 and up per week. The following are a few of them:

Farm Lighting Experts
$60 a Week and up
Armature Experts
$50 a Week and up
Power House Operator
$50 a Week and up
Auto Electrician
$60 a Week and up
Inventor
Unlimited Income
Maintenance Engineer
$60 a Week and up
Service Station Owner
$60 a Week and up
Radio Expert
$60 a Week and up
Contractor
$3,500 a Year and up

Send for Free Book

Just give me a chance to tell you about the unlimited opportunity that awaits you. Let me send you big book free, containing over 150 photographs—listing and telling you how you can qualify for the kind of jobs that lead to salaries of $50 a week and up. If you really want more money and a wonderful future send for this book now!

No obligation. Simply mail the coupon.

Mail This FREE BOOK Coupon To-day

COYNE ELECTRICAL SCHOOL *Est. 1899*

H. C. LEWIS, Pres. Dept. 28-83 500 S. Paulina St., Chicago, Ill.

Coyne Electrical School, *H. C. Lewis, Pres.*
Dept. 28-83 500 So. Paulina St., Chicago, Ill.

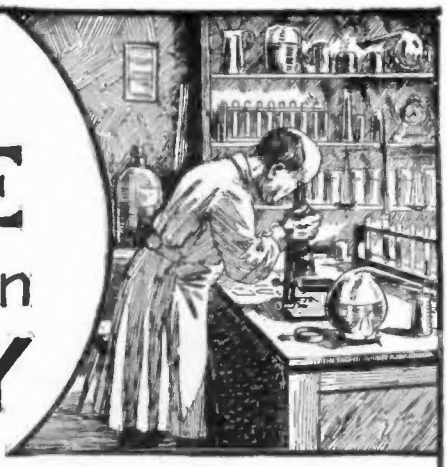
Dear Mr. Lewis: Without obligation send me your big free catalog and all details of Free Employment Service, Radio and Automotive Electrical Courses and how many "earn while learning". I understand I will not be bothered by any salesman.

Name .....

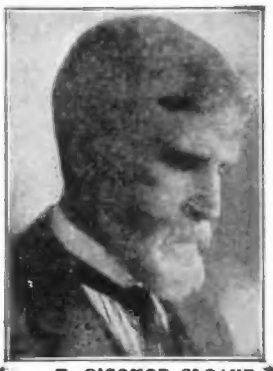
Address .....

City ..... *State* .....

BURIED TREASURE can still be found in CHEMISTRY



Good Chemists Command High Salaries



T. O'CONOR SLOANE, A.B., A.M., LL.D., Ph.D.
Noted Instructor, Lecturer and Author. Formerly Treasurer American Chemical Society and a practical chemist with many well known achievements to his credit. Not only has Dr. Sloane taught chemistry for years but he was for many years engaged in commercial chemistry work.

You can make yourself independent for life by unearthing one of chemistry's yet undiscovered secrets.

Do you remember how the tales of pirate gold used to fire your imagination and make you want to sail the uncharted seas in search of treasure and adventure? And then you would regret that such things were no longer done. But that is a mistake. They *are* done—today and everyday—not on desert islands, but in the chemical laboratories throughout your own country. Quietly, systematically, the chemist works. His work is difficult, but more adventurous than the blood-curdling deeds of the Spanish Main. Instead of meeting an early and violent death on some forgotten shore, he gathers wealth and honor through his invaluable contributions to humanity. Alfred Nobel, the Swedish chemist who invented dynamite, made so many millions that the income alone from his bequests provides five $40,000 prizes every year for the advancement of science and peace. C. M. Hall, the chemist who discovered how to manufacture aluminum made millions through this discovery. F. G. Cottrell, who devised a valuable process for recovering the waste from flue gases, James Gayley, who showed how to save enormous losses in steel manufacture, L. H. Baekeland, who invented Bakelite—these are only a few of the men to whom fortunes have come through their chemical achievements.

What Some of Our Students Say of This Course:

I have not written since I received the big set. I can still say that it far exceeded my anticipations. Since I have been studying with your school I have been appointed chemist for the Scranton Coal Co. testing all the coal and ash by proximate analysis. The lessons are helping me wonderfully, and the interesting way in which they are written makes me wait patiently for each lesson.—MORLAIS COUZENS.

I wish to express my appreciation of your prompt reply to my letter and to the recommendation to the General Electric Co. I intend to start the student engineering course at the works. This is somewhat along electrical lines, but the fact that I had a recommendation from a reliable school no doubt had considerable influence in helping me to secure the job.—H. VAN BENTHUYSEN.

So far I've been more than pleased with your course and am still doing nicely. I hope to be your honor graduate this year.—J. M. NORKUS, JR.

I find your course excellent and your instruction, truthfully, the clearest and best assembled I have ever taken, and yours is the fifth one I've studied.—JAMES J. KELLY.

From the time I was having Chemistry it has never been thus explained to me as it is now. I am recommending you highly to my friends, and urging them to become members of such an organization.—CHARLES BENJAMIN.

I shall always recommend your school to my friends and let them know how simple your lessons are.—C. J. AMDAHL.

I am more than pleased. You dig right in from the start. I am going to get somewhere with this course. I am so glad that I found you.—A. A. CAMERON.

I use your lessons constantly as I find it more thorough than most text books I can secure.—WM. H. TIBBS.

Thanking you for your lessons, which I find not only clear and concise, but wonderfully interesting. I am—ROBT. H. TRAYLOR.

I received employment in the Consolidated Gas. Co. I appreciate very much the good service of the school when a recommendation was asked for.—JOS. DECKER.

Experimental Equipment Furnished to Every Student

We give to every student without additional charge this chemical equipment, including forty-nine pieces of laboratory apparatus and supplies, and forty different chemicals and reagents. These comprise the apparatus and chemicals used for the experimental work of the course. The fitted heavy wooden box serves not only as a case for the outfit but also as a useful laboratory accessory for performing countless experiments.

Now Is the Time to Study Chemistry

Not only are there boundless opportunities for amassing wealth in Chemistry, but the profession affords congenial employment at good salaries to hundreds of thousands who merely follow out its present applications. These applications are innumerable, touching intimately every business and every product in the world. The work of the chemist can hardly be called work at all. It is the keenest and most enjoyable kind of pleasure. The days in a chemical laboratory are filled with thrilling and delightful experimentation, with the alluring prospect of a discovery that may spell Fortune always at hand to spur your enthusiasm.

You Can Learn at Home

To qualify for this remarkable calling requires elaborate specialized training. Formerly it was necessary to attend a university for several years to acquire that training, but thanks to our highly perfected and thorough system of instruction, you can now stay at home, keep your position, and let us educate you in Chemistry during your spare time. Even with only common schooling you can take our course and equip yourself for immediate practical work in a chemical laboratory. Dr. Sloane gives every one of his students the same careful, personal supervision that made him celebrated throughout his long career as a college professor. Your instruction from the very beginning is made interesting and practical, and we supply you with apparatus and chemicals for performing the fascinating analyses and experimental work that plays such a large part in our method of teaching, and you are awarded the Institute's official diploma after you have satisfactorily completed the course.

Easy Monthly Payments

You don't have to have even the small price of the course to start. You can pay for it in small monthly amounts—so small that you won't feel them. The cost of our course is very low, and includes everything, even the chemistry outfit—there are no extras to buy with our course. Our plan of monthly payments places a chemical education within the reach of everyone. Write us and let us explain our plan in full—give us the opportunity of showing you how you can qualify for a highly trained technical position without even giving up your present employment.

TUITION PRICE REDUCED

Besides furnishing the student with his Experimental Equipment, we have been able, through the big increase in our student body, to reduce the cost of the course. Write today for full information and free book, "Opportunities for Chemists." Send the coupon right now, while it is fresh in your mind. Or just write your name and address on a postal and mail it to us.

DON'T WAIT—MAIL COUPON NOW!

CHEMICAL INSTITUTE OF NEW YORK, Inc.
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CHEMICAL INSTITUTE OF NEW YORK
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NEW YORK CITY

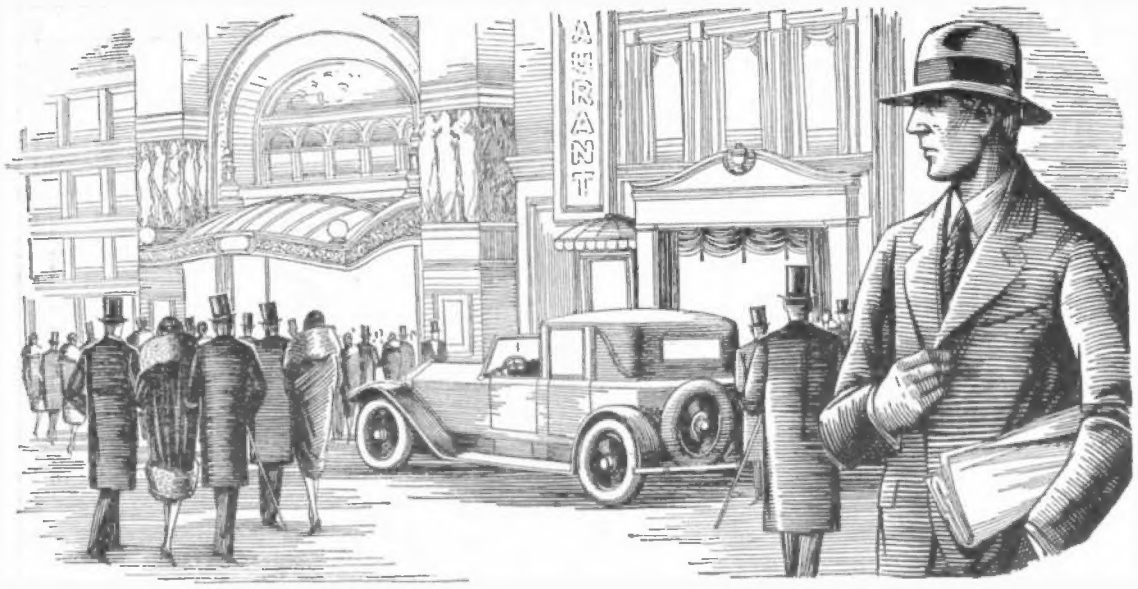
Please send me at once, without any obligation on my part, your free Book "Opportunities for Chemists," and full particulars about the Experimental Equipment given to every student. Also please tell me about your plan of payment and the reduction in the tuition price.

NAME .....

ADDRESS .....

CITY ..... STATE.....

S. & I.—2-28



Always outside of things—that's where I was just twelve short months ago. I just didn't have the cash, that was all. No theatres, no parties, no good restaurants. No real enjoyment of life. I was just getting by, just existing. What a difference today! I drive my own car, have a good bank account, enjoy all the amusements I please.

I Couldn't Get the Good Things of Life

Then I Quit My Job and "Found" Myself

HOW does a man go about making more money? If I asked myself that question once, I asked it a hundred times!

I know the answer now—you bet. I know the way good money is made, and I'm making it. Gone forever are the days of cheap shoes, cheap clothes, walking home to save carfare, pinching pennies to make my salary last from one pay-day to the next one. I own one of the finest Radio stores you ever saw, and I get almost all the Radio service and repair work in town. The other Radio dealers send their hard jobs to me, so you can see how I stand in my line.

But—it's just a year ago that I was a poorly-paid clerk. I was struggling along on a starvation salary until by accident my eyes were opened and I saw just what was the matter with me. Here's the story of just how it happened.

One of the big moments of my life had come. I had just popped the fatal question, and Louise said "Yes!"

Louise wanted to go in and tell her father about it right away, so we did. He sort of grunted when we told him the news, and asked Louise to leave us alone. And my heart began to sink as I looked at his face.

"So you and Louise have decided to get married," he said to me when we were alone. "Well, Bill, just listen to me. I've watched you often here at the house with Louise and I think you are a pretty good, upstanding young fellow. I knew your father and mother, and you've always had a good reputation here, too. But just let me ask you just one question—how much do you make?"

"Twenty-eight a week," I told him.

He didn't say a word—just wrote it down on a piece of paper.

"Have you any prospects of a better job or a good raise some time soon?" he asked.

"No, sir; I can't honestly say that I have," I admitted. "I'm looking for something better all the time, though."

"Looking, eh? How do you go about it?"

Well, that question stopped me.

How did I? I was willing to take a better job if I saw the chance all right, but I certainly had laid no plans to make such a job for myself. When he saw my confusion he grunted. "I thought so," he said, then he held up some figures he'd been scribbling at.

"I've just been figuring out your family budget, Bill, for a salary of twenty-eight a week. I've figured it several ways, so you can take your pick of the one you like best. Here's Budget No. 1: I figure you can afford a very small unfurnished apartment, make your payments on enough plain, inexpensive furniture to fix such an apartment up, pay your electricity, gas and water bills, buy just about one modest outfit of clothes for both of you once a year, and save three dollars a week for sickness, insurance, and emergencies. But you can't eat. And you'll have to go without amusements until you can get a good substantial raise in salary."

I began to burn red as fire.

"That budget isn't so good after all," he said, glancing at me; "maybe Budget No. 2 will sound better——"

"That's enough, Mr. Sullivan," I said. "Have a heart. I can see things pretty clearly now; things I was kidding myself about before. Let me go home and think this over." And home I went, my mind in a whirl.

At home I turned the problem over and over in my mind. I'd popped the question at Louise on impulse, without thinking it out. Everything Mr. Sullivan had said was gospel truth. I couldn't see anything to do, any way to turn. But I had to have more money.

I began to thumb the pages of a magazine which lay on the table beside me. Suddenly an advertisement seemed almost to leap out at my eyes, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day seems almost like a dream to me now. For ten of those twleve months I've had a Radio business of my own! At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the institution that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business, such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making real money. Louise and I have been married six months, and there wasn't any kidding about budgets by Mr. Sullivan when we stepped off, either. I'll bet that today I make more money than the old boy himself.

Here's a real tip. You may not be as bad off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—no matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. 2T, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. 2T, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesmen will call on me.

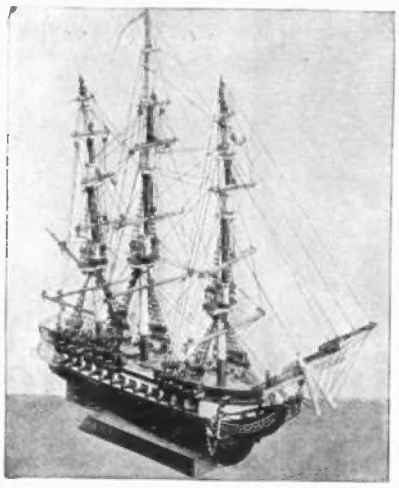
Name.....

Address.....

Town ..... State

Build a Ship Model

CAN BE PUT TOGETHER BY A SCHOOL BOY IN A FEW HOURS



$6.98 CONSTITUTION
Size.
26" high; 27" long; 8½" wide

15-Year-Old Schoolboy Wins First Prize

$12.50 LA PINTA
Ship Model Loudspeaker
Size:
26" high; 27" long; 12" wide

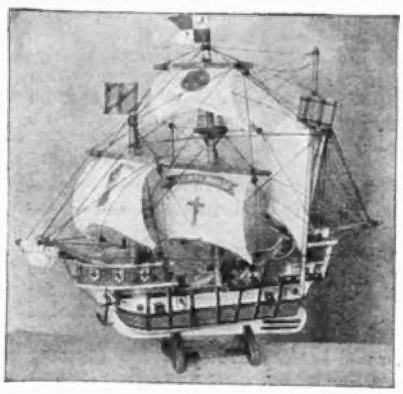
A historical ship model should be in every home. We supply all the parts, cut to fit, and ready to put together. Every part necessary to construct any of the models pictured. A full diagram of numbered parts comes with every kit, with full detailed instructions so that it is impossible to make a mistake. All you need is a small hammer to tap parts in place. Here is a part of the instructions copied from the regular sheet that comes with every kit. Take part No. 57, place it at the front end of No. 56, and down on No. 55. Next take part No. 58 and place it at the rear end of No. 56, and tap in place with a small hammer.

So clear are the instructions that the 15-year-old boy pictured above won First Prize in a model contest held by the publishers of Science and Invention Magazine. Hundreds of ship models were entered from all parts of the country. This model was constructed from a regular kit of our parts. The educational and historical value a boy gains in constructing one of these models cannot be measured in dollars and cents. Boys like to build things They learn while they build.

These models, with the exception of the Constitution, may be converted into a beautiful toned loudspeaker that serves a double purpose, being useful as well as beautiful. The mainsail acts as the diaphragm, and is driven by a unit of the electro-magnet type. This is attached to the mainmast, which is imbedded in the hull. Power amplification is not needed, as the unit will operate a 72-in. cone. This assures you faithful reproduction at all frequencies.

These Ship Models are not only for boys, but make a beautiful gift for everyone. Doctors, Lawyers, Business Men, Nurses, Stenographers and Housewives all over the country have built models from our complete kit of parts. They have become so interested in building the first model that, in many cases, they have sent for the parts to construct all our models. Ship Model building is indeed a fascinating pastime.

$4.98 MAYFLOWER
Size
25" high; 10" wide; 26" long



$4.98 SANTA MARIA
Size:
25 "high; 11" wide; 27" long

Sold on money-back guarantee
ALL GOODS SHIPPED SAME DAY ORDER IS RECEIVED

When the model is completed it makes one of the finest home decorations that money can buy, and the adventure of building your own models adds zest to the achievement. You will be proud of your model because you are the builder.

MINIATURE SHIP MODELS, Inc.
3818-20-22-24 Baring St., Philadelphia, Pa.
Canadian Branch: 1485 Bleury St., Montreal, Canada
Canadian Prices Slightly Higher. Send all Canadian Orders to Canadian Office.

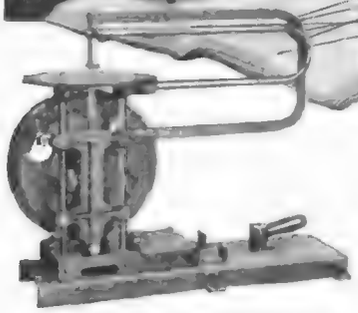
MINIATURE SHIP MODELS, Inc., Dept. S-5
3818-20-22-24 Baring St., Phila., Pa.

Please send me complete parts, cut to fit and ready to assemble, for the Constitution, $6.98 ☐; Santa Maria, $4.98 ☐; La Pinta, $4.98; ☐; Mayflower, $4.98 ☐. Melody Ships: La Pinta, $12.50 ☐; Santa Maria, $12.50 ☐; Mayflower, $12.50 ☐. I will pay postman purchase price plus postage (a few cents).
Check which model you want shipped.
Catalog only ☐

PLEASE PRINT NAME AND ADDRESS PLAINLY

Name.....
Street or R. F. D. No.....
City.....
State.....

I'll loan you a SpeedWay Shop-just to prove you can make things like this!

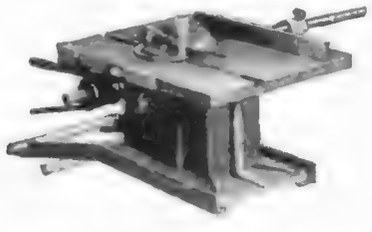


Handy Jig Saw

This Pattern Maker's Jig Saw is part of the Model "88" Shop. Follows a perfect line. Extra blades included free.

Practical Bench Saw

Built heavy and strong. Set into place and operated in five seconds. Rips, mitres, grooves, and cross-cuts.



Get Your Magazine Basket Quick !

While they last, we are giving away the lumber to make the beautiful magazine basket shown down in the lower left-hand corner. It is yours to keep even if you should decide to return the Shop. Act at once before they are all gone. Instructions for making it are included, of course.

Yours for the Asking

Everyone who fills in and mails the coupon will receive free of all charge, illustrated plans and instructions for making this beautiful Priscilla Sewing Cabinet. Perhaps you read about it in a recent issue of a well-known magazine but I want to show you how to make it in one fourth the time on my MOTORIZED work bench—the Speedway Shop!

Discard Your Hand Tools

Don't let hand tools put a limit on your Craftsmanship. Let me show you how to start with this simple Priscilla Cabinet—go on into grooving, mitreing, mortising, scroll work, wood turning—make Humidors, Fancy Gateleg Tables, etc. Why limit your ingenuity when it is so easy to own a SpeedWay Shop? Remember—SpeedWay is the Shop used by Manual Training instructors everywhere.

Motorize Your Workbench

You can be sure you're getting the right shop when you realize that SpeedWay alone has been serving the World's Industries with Portable Electric Tools for the last twenty years. I want you to examine the exclusive features of a SpeedWay Shop.

ELECTRO MAGNETIC TOOL CO.

Department 3-F **1832 So. 52nd Avenue**

Cicero (Adjoining Chicago) Illinois

Trivial Down Payment

We'll show you how to earn or save the small down payments that come due just once a month. So simple too, for any man who knows his ABC's about tools. Ask what Mr. Watts of Miami, Fla. did. Send in coupon today!

Free Trial and Instructions—Free Plans and Materials

We are anxious that every owner of a SpeedWay Shop shall get the maximum pleasure and profit from it. That's why we have established the SpeedWay Personal Service Department.

24 Blue Prints Free

With each Shop we include 24 Blue Prints of Furniture, Toys, etc., that anyone can make with the SpeedWay Shop. Mr. L. L. Hull, in charge of our Personal Service Department, will answer your special questions. Here is a real service department at your beck and call.

Free Crafts Book

When we receive your coupon we will send you a list of the best books on Craftsmanship from which to make your selection to be sent free with your Shop.

Quick Action Needed

We cannot continue Special Offers like this indefinitely. Use the coupon today, and we will send the Priscilla Cabinet plans and Instructions at once! Mail today!

MAIL TODAY

Electro Magnetic Tool Co.,
Dept. 3-F, 1832 So. 52nd Ave., Cicero, Ill.
Gentlemen: Please send me free the complete plans and instructions for making the Priscilla Sewing Cabinet shown above. Also complete details about your Shop and free offers.

Name .....
Street .....
City ..... State .....
My age is ..... Occupation .....
I will use Shop for fun ☐ or profit ☐

"What Has 'Come Over' Jimmy Smith? ---He's A *New Man!*"

"SURELY that *can't* be Jimmy Smith! What on earth has come over him? Why, Jimmy *used* to be a meek, apologetic sort of chap who looked as though he was half afraid of himself.

"But look at him *now*!—swinging snappily down the street, bubbling over with confidence, keen and alert, dressed in expensive clothes, and looking as though he's just come into a million dollars. What on earth has produced this amazing change in him?"

New Thrills For You

You can imagine the joyous thrill Jimmy experienced as he overheard his friends make these remarks. And later, when he stopped and told them all about it—how he had literally "made himself over," and was now a big success.

This is a true-life incident, which actually happened to "Jimmy" Smith, who lives in Cleveland, although, of course, that's not his real name. Hundreds of others have done it, too. *You* can do it. You can actually "make yourself over" in a remarkably short time. Like many people, you may be lacking in self-confidence. Or embarrassed in the presence of others. Or of a sensitive, retiring disposition that causes you to take a back seat while others push themselves forward and get ahead of you.

By doing a very simple thing you can throw off these handicaps to success. You can quickly develop the delightful poise and self-assurance of a widely-traveled man of the world. You can be sure of yourself and able to meet, talk with, and hold your own with anyone and everyone under any and all conditions.

Amazing Things That You Can Do

How to—

—increase your income.
—get ahead quicker.
—charge yourself with energy.
—use "hidden powers" to help you in emergencies.
—win friends, love, and companionship.
—build supreme self-confidence.
—develop a charming, magnetic personality.
—get new, wonderful thrills out of life.
—know the secrets of joyous health.
—understand the vital facts about sex life.
—overcome fear, discouragement, worry, nervousness, etc.

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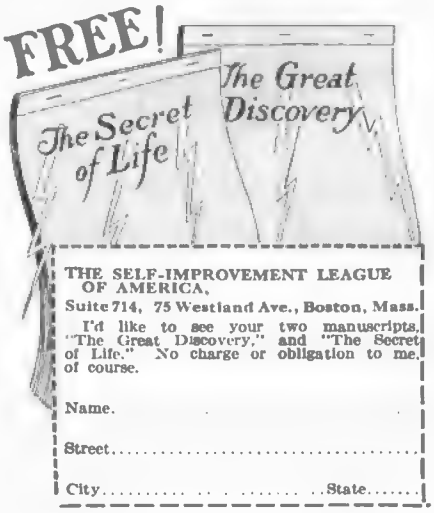

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"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact" - - - HUXLEY

DO WE LIVE IN A SUPRA-WORLD?

By HUGO GERNSBACK

A FISH swimming in the water, its natural element, is not aware of the fact of the water itself. A six year old child does not realize that it lives in a very dense medium—air. Yet, the air exerts a pressure upon the human body of almost fifteen pounds to the square inch of its surface. Only by waving our hands rapidly through the air do we become conscious that we are immersed in a perfectly transparent fluid.

It is this ocean of air in which we live that prevents us from actually knowing what is outside of that ocean. For instance, a deep sea fish near the bottom of the ocean, is not conscious that there might be another world outside of the water, and even if he was a thinking individual he could hardly comprehend that such a world could exist in a different sort of fluid.

Carrying this analogy a little further, we may ask ourselves the question: What is outside our earth? What does our outer space consist of, and what are the *properties* of this outside space?

Astronomers have been telling us for many years, that for one thing, outer space is practically a vacuum, there being of course, no atmosphere. The proof of this is easy to obtain astronomically, as for instance, we know today from observations of astronomers that there is practically no air on the moon, our nearest neighbor. The moon eclipses a star instantaneously—a phenomenon impossible if the moon had an appreciable atmosphere. If there is an atmosphere, it clings quite close to the moon, and certainly does not extend more than a few hundred feet from the surface, whereas, the atmosphere of the earth does not extend for over 600 miles above its surface.

Science now knows that outer space contains no heat whatsoever, and that all space is at an absolute zero, which, expressed in figures, is minus 459.4° Fahrenheit. These are well-known facts, and have been known for years, but the experiments of excessive degrees of cold by Professor Kamerlingh Onnes at the University of Leyden, made during the past few years, have given us a great deal of food for thought. Professor Onnes, by means of liquifying helium, has been able to closely approach absolute zero, when he reached the low temperature of minus 457.6°F. This approaches the absolute zero closely. At such extremely low temperatures, a number of astonishing things begin to happen.

As is well known, an electric current traversing a conductor, gives rise to heat. If the conductor passes a sufficient current it becomes white hot, as for instance the filament in an incandescent lamp. But if you took the same electric lamp bulb into outer space hundreds of miles above the earth's surface and tried to light it up with the identical current, a most surprising thing would be seen. You would find that it no longer would light, for the simple reason that at such extreme colds, all conductors of electricity lose their resistance entirely. Professor Onnes in this manner, was enabled to send tremendous currents through very thin conductors, that would ordinarily have become white hot and burn up or volatilize. Under such extreme colds, conductors are termed *supra-conductors*, because they become supra-conductive to the electric current. But that isn't all. Inasmuch as metallic wires in absolute zero lose all resistance, it is possible to start an electric current in a conductor, and that current will keep on flowing without stopping. In other words, here we have a sort of perpetual motion, but of course, it requires so much power to obtain it, that it would not be practical.

Now let us see what happens out in space if we apply this reasoning to astronomy. I believe the thoughts which I present herewith have not been considered up to this time.

Light rays, being of electro-magnetic nature, it would seem that they would fall under the classification of supra-conductors. In a sense, it is therefore quite possible that the light which we obtain from the sun, for instance, comes to us without any appreciable loss, whatsoever, because space being at an absolute zero, will offer no resistance to the passage of the light rays, and the latter, therefore, are not at all weakened in the passage from the sun to the earth. No energy is consumed while they traverse 92 million miles. This would give an excellent explanation why light, and the subsequent transformation to heat of the sun's rays suffer no appreciable loss at all in transit. It would also appear that the sun furnishes no energy to space itself, except where the rays strike a celestial body, such as the earth or the other planets. This would be similar to an alternating current generator, that runs practically idle, as long as no current is used at the far end of the line. Yet the line wires are there, and while there must be potential changes in the line, still no current is being used until the load is put across the line.

It would also appear, that gravitation, whatever its nature, would fall into the classification of the supra-conductor. This would explain many celestial phenomena that are obscure today. For instance, it can be proved, that the earth revolving around the sun has a centrifugal force, similar to that developed by the action of the boy who swings a weight around his head by means of a string. The faster he spins the weight, the more strain there is on the cord. Yet, the earth spins around the sun at the tremendous velocity of 65,000 miles an hour, but there is no string to hold the earth to the sun. Indeed, the speed is so great, that you would need a cable almost as large in diameter as the earth itself, according to theoretical calculations, to keep the earth from flying out into space at a tangent. Yet, there is no chain holding the earth to the sun, and the earth does not fly out into space. What holds the earth in its orbit against this tremendous pull? Science will tell us that it is gravitation, but this is but a poor answer to the question: it is only a name.

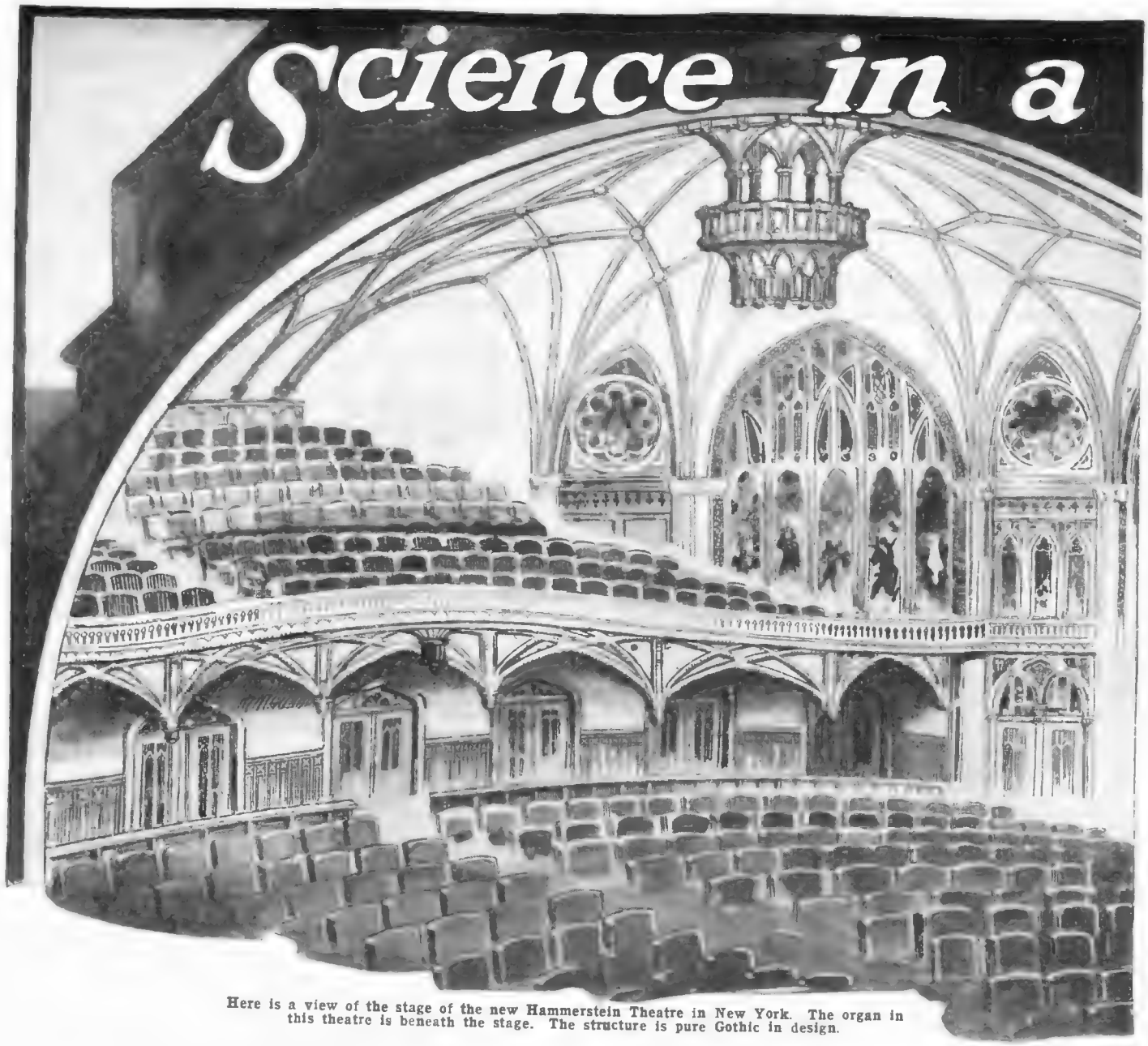
It would seem, therefore, that we should think of gravitation as some invisible, yet solid enough chain, which is actually in existence. But gravitation probably being a supra-conductor, that is, of no resistance, it becomes now fairly simple to our imagination, because a supra-conductor can transmit a practically infinite amount of power through an infinitely small conductor, and if gravity is this conductor, a lot of things become clearer to our understanding.

It even opens up new avenues for inter-stellar space flying, because we can imagine a small electric generator operating outside of our space flyer and therefore immersed in absolute zero. Once started, such a machine would furnish current without stopping, which could be used for navigation, when the principles of gravitation are fully understood and harnessed.

One thing is sure, we are learning much from supra-conductors. We know for instance, that although perpetual motion on a practical scale is perhaps never possible on earth, yet the earth and the rest of the planets are perpetual motion machines, in a practical sense. The earth, the moon and the other planets revolve about the sun, and require no power, once they had been started. They have thus revolved for millions of years. This, no doubt, is because we live in a supra-world, that has no resistance and offers no resistance to anything once it has been started in motion. It is the most ideal frictionless machine imaginable, and the most economical that could be evolved.

Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Station WRNY on various scientific and radio subjects.

Science in a



Here is a view of the stage of the new Hammerstein Theatre in New York. The organ in this theatre is beneath the stage. The structure is pure Gothic in design.

Storm, with the Entire Stage Flooded with Rain in One Moment and Entirely Dry the Next, Makes the Presentation of "Golden Dawn" Wonderfully Spectacular

By JOSEPH H. KRAUS

IN the new Hammerstein Theatre, recently opened in New York City, we find many architectural wonders, unique in theatre design. The auditorium itself is of pure Gothic design. Beautiful leaded glass panels emblazon the wall. Suspended from the center of the dome-like ceiling, there is an immense Gothic lamp of quite unusual design. The windows themselves are illuminated from behind and most of the lighting effects in the entire theatre are either indirect or semi-indirect. Instead of the organ pipes being arrayed on either side of the proscenium opening, the organ is found in a large sound-proof room immediately beneath the stage. The organ music issues through baffle-controlled openings to the auditorium.

The largest pipe in this organ is 16 feet long. The room itself is immense, yet filled with pipes in such a fashion that one wonders how it is possible for a man to move in and out among them, when changing or tuning them properly. Even the cathedral gongs are confined in this sound-proof room beneath the stage, which is provided with baffles, so that the volume can be controlled at the will of the organist. The console itself is on a special platform which can be raised or lowered by a motor-driven screw; thus the operator at the console can bring himself into view or can gradually descend beneath the stage-floor level. A second control will be found on the switchboard to one side and a little above the stage-floor level.

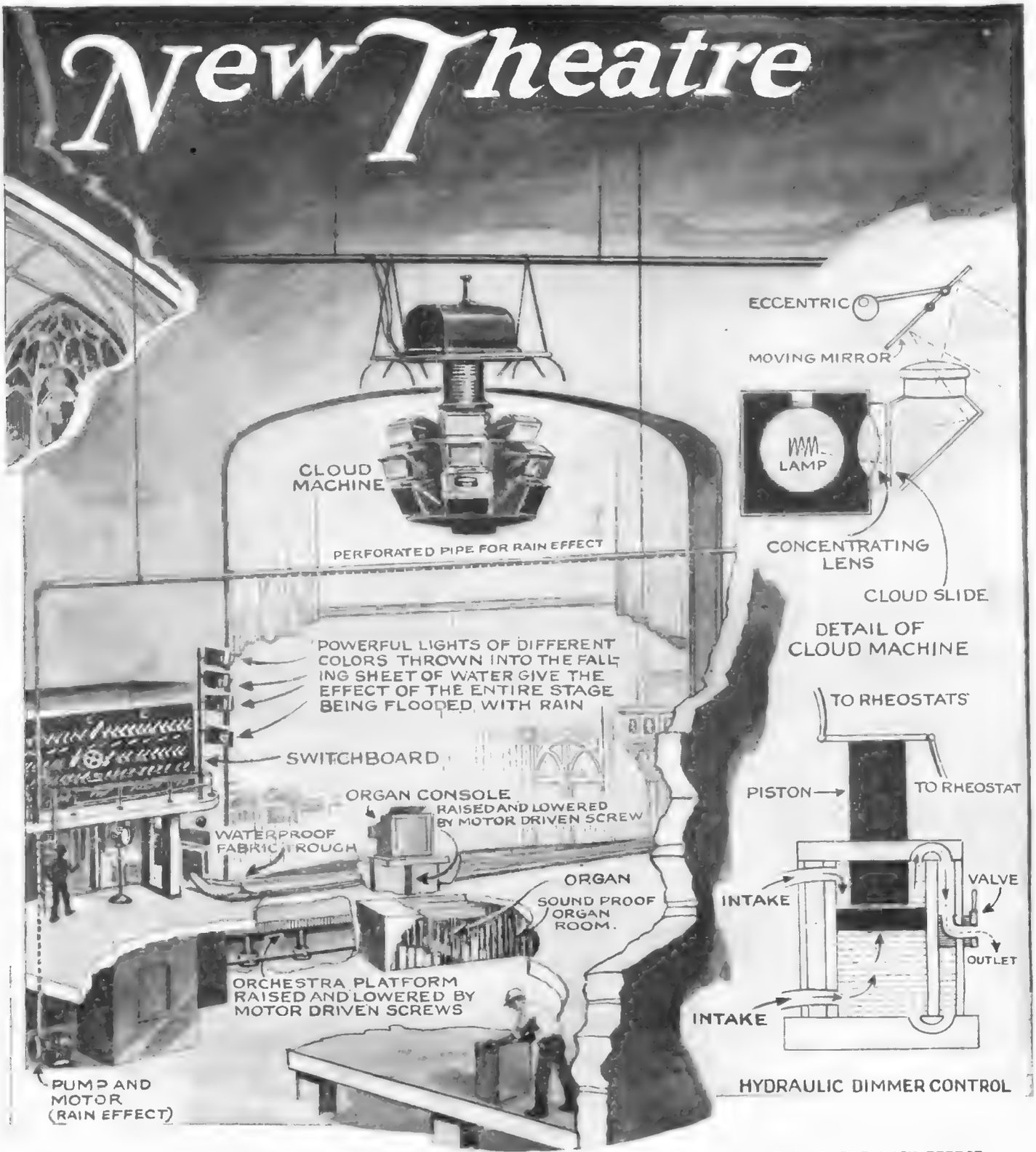
ORCHESTRA APPEARS ON RISING PLATFORM

The same feature is applicable to the orchestra because the entire orchestra platform can be raised and lowered by motor-driven screws. The electric motor is coupled to a shaft at one end, and it communicates the power through a worm operating a series of screws located under the platform. In this way the orchestra can be made to rise fully into view, or to disappear from sight, and even leave their position in the pit without anyone knowing it.

THE MARVELOUS ELECTRIC SWITCHBOARD

A word or two now concerning the switchboard for which Mr. Dolan, Mr. Hammerstein's electrician is largely responsible. While this is quite a large affair, it is much smaller than those found in theatres of the same size. Here we see merely a series of handles, interspersed with a few pilot lights, and a single master control wheel. These handles are so arranged that they can be twisted to the right or left, engaging in a slotted disk. Ordinarily such switches are manipulated by hand, or operated by rapidly turning a large screw which communicates the motion to all of the switches arranged in tandem but not so at this new theatre. Here we find a hydraulic control dimmer. This is so arranged that it operates all of the rheostats by moving a piston approximately eight inches in diameter up or down. The diagram for the dimmer control is briefly indicated in the insert on these pages. It will be found that when the valve is turned as illustrated, that the piston will have a tendency to move upward if water is let in through the bottom opening. This movement can be so controlled that the lights do not completely dim for several hours, or can be made so rapid that the effect is practically like a flash. At the same time that one of the groups of lights are being gradually dimmed, another group can be made to light up thus producing a perfect dissolve. It is

New Theatre



really uncanny to watch this switch board fairly operate itself.

THE CLOUD PRODUCER

Depending from the grid we find a most unique cloud machine used in one of the scenes in the "Golden Dawn," now playing at the theatre. The "Golden Dawn" is a musical drama of intense appeal. In one of the scenes, a storm is required and here is one place where we have it. Lightning, thunder and rain, torrents of it—it seems as though the whole stage is flooded. The clouds roll from one end of the horizon to the other, and then roll back again. They are absolutely true to nature, and yet far more perfect than they could ever be obtained with a motion picture machine.

The cloud machine consists of a large multiple lens multiple mirror projector, rotating about a center point, the rotation being controlled by a motor. For each lens we find an oscillating mirror which can be controlled from the switchboard to operate slowly or very rapidly. It is these oscillating mirrors which cause the clouds to roll about violently. The housing contains a three thousand watt special incandescent bulb, the light of which after passing through a condensing lens, passes through a slide which is an actual photograph of cloud formation. The slide itself is only one of the series, the entire group being mounted in the ring of projectors. Between the incandescent bulb and the lenses, a vignette of tin is employed which cuts down the possible cloud projections on the building, trees, and other scenery, and limits the projection of clouds to the sky portion of the horizon. The lightning and rumble of thunder are produced in the well know stage-time methods.

REMARKABLE RAIN EFFECT

In order to produce the effect of the storm, a perforated pipe is mounted in back of the proscenium opening. This is supplied with water under pressure and the water is caught in a water-proof fabric trough made to represent the foreground of the scene. This trough is raised at both ends and does not communicate with any drain or other disposal method. Now when it comes time for the storm, and the sky darkens, and after we hear the distant rumbling of thunder, we see a down-pour, the like of which has probably never been duplicated on any New York stage. It appears as if the entire stage from the footlights to the back wall were flooded, yet when the curtain rises again, the water has miraculously disappeared and strange to say, the artists costumes are all dry. The illusion of depth to the effect is obtained by proper lighting.

Motor-Whip *for* Ice Skaters

By HUGO GERNSBACK

The motor-whip is here seen in action on an ice-covered pond. A brand new sport.

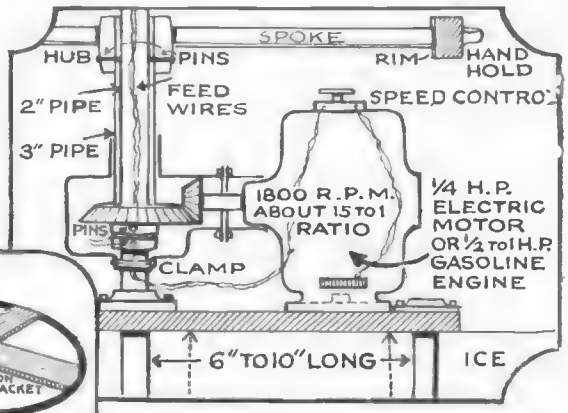
ICE skaters are constantly looking for new pleasure, and any new ice sport that comes along, is usually greeted with enthusiasm. Some years ago, I constructed a simple apparatus which I termed the *Motor-Whip*, and which was used with excellent results on a small lake, in the country. The idea is very simple, and consists in a few words, of a large wagon wheel attached to a small fractional horsepower electric motor. The wagon wheel has ordinary handles, attached at its circumference, as shown in the illustration. The wheel revolves at a fair speed, not too great to make the sport dangerous; say about two revolutions per second or 120 revolutions per minute. The skater comes along, grabs one of the handles and whirls around, one complete turn. At a predetermined point, he releases his hand hold, and the motion imparted to him by the wheel, shoots him off at a tangent. The game is supposed to be played in such a fashion, that the skater is not allowed to move his feet to assist the propulsion speed which he has obtained from the wheel.

Naturally, the distance traversed by the skater is determined by a number of factors, such as sharpness of skates, weight of the skater, wind resistance, skill in skating, that is, keeping both feet strictly parallel, and other minor points.

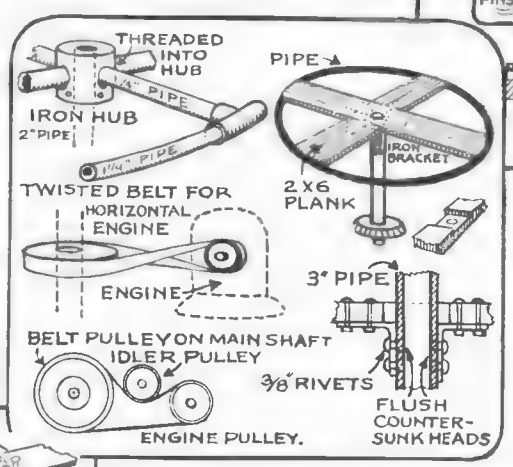
The sport, however, does not consist of this one method alone, but a number of games have been evolved by me, and which are also shown in the illustration. For instance, in figure 1, a double whip is shown, where two skaters are flung out. Thus, the contest can be staged between couples, seeing which one goes out the furthest; the one going the furthest, naturally getting credited with the highest amount of points.

In Figure 2, another simple arrangement is shown, where a marker, with a flag, is stationed on the ice. The skater's problem is to round that marker one full turn, and then it is up to him to see how much further he can go on towards the goal as shown.

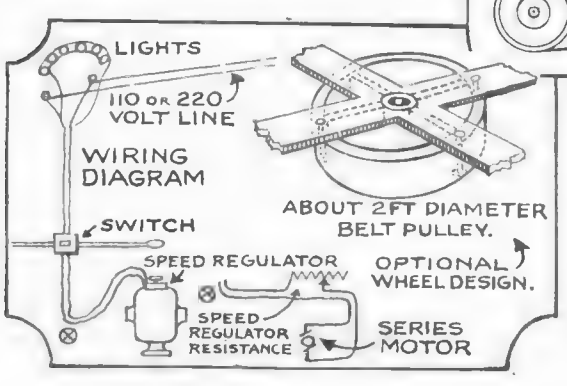
It should be understood, that this entire sport revolves about the fact, that a skater at no time must move either his feet or legs to actually propel himself. The feet are not to be lifted from the ice and must be held close together, parallel. Referring again to figure 2, it will be seen that a good deal of skill



Sectional view through motor-whip showing spur-gear drive from electric motor. The gear teeth ratio may be about 15 to 1.



Two other designs of home-made wheels for the motor-whip are shown above, together with several hints for various belt drives.



Wiring diagrams for the motor, as well as the lights atop the pole, are shown below; together with an optional design of home-made wheel. In this design of wheel, two by six-inch planks are mortised at the center, and bolted to a standard machine belt pulley, the hub of which clamps to the revolving shaft.

is required to round the marker, and yet enable the skater to cover a fair distance after he has thus rounded it. After a number of trials, more skill is acquired, and

Above we see two skaters who are holding on to the wheel, hand in hand. The sport increases by holding on in this manner. Fig. 1.

the skater becomes more proficient. In Figure 3, we have a similar arrangement, whereby two markers or goal posts have to be rounded in the Figure 8 style, and after successfully negotiating the figure 8, the skater tries to cover a further distance if he can do so. Another variation in the same sport is shown in figure 4, where a number of markers have to be negotiated. Of course, most skaters will never be able to negotiate all of them, unless they are quite skillful. Their speed has been reduced a great deal in the negotiation of each subsequent marker, for it must be remembered, that every time the skater leans sideways, a braking action occurs, which cuts down the speed.

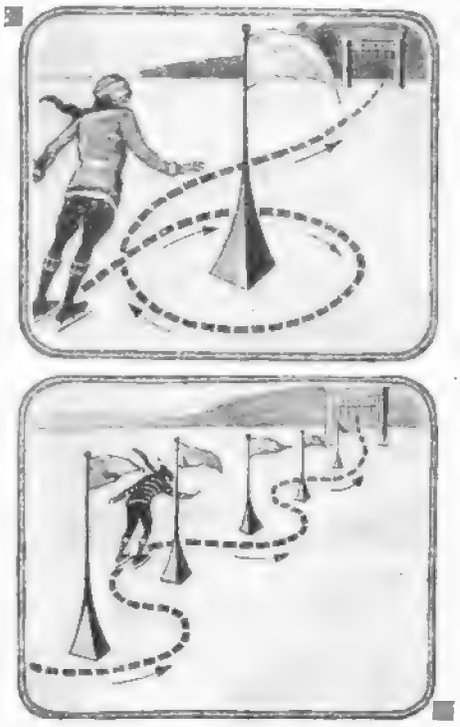
These few examples have only been given to elucidate what can be done. Of course, there are many others that the skaters themselves can work out, as for instance backward flipping; one skater backward and the other forward, etc. The apparatus is not difficult of construction. Any good electrician or anyone handy with tools and machinery can build one for a few dollars. An old second-hand motor will come in good stead, and the entire outfit can be built for a nominal amount.

The apparatus which I originally built was mounted on a number of heavy planks, about 5 feet square. The wheel itself, was a 6 foot light wagon wheel. After the ice had formed, the apparatus was taken out on the ice and then secured by means of four wooden pegs into the ice, where they were frozen in after a few hours. The apparatus was left in this position until the end of the skating season or as soon as thaw threatened by weather report; then it was moved to the land in a safe position, so it would not sink.

The apparatus also was equipped with a number of electric lights so it could be used by night as well, giving sufficient illumination for all purposes. An installation like that shown and the entire construction of the apparatus, with the second-hand motor excepted, with all labor amounted to less than $30.00. In the detailed illustrations, sufficient technical data has been given to enable anyone handy with tools and machinery to build the Motor-Whip. Of interest, is the handle which extends both ways on top of the wheel. This motor switch handle does not revolve, but remains stationary. This handle works the switch, which operates the motor wheel. Thus the switch can be turned on or off by the skaters at will, simply by reaching over in case it is desired to start or stop the motor.

For those technically inclined, further information is given underneath the illustrations. This gives sufficient data for the builder. The important thing to remember is that the base upon which the entire apparatus rests must be quite solid, and should not wobble, inasmuch as considerable strain is put upon the support and for that reason the plank or planking supporting the wheel must be well anchored in the ice. The more support there is, the better the apparatus will work. Be sure that it is absolutely solid, and does not move sideways in any respect. Usually by taking a pail of water and pouring it under the planking, enough ice will form to secure a good support.

At one time, when thaw threatened, it was necessary to remove the apparatus quickly, and this was done, simply by pouring a few pails of hot water around the planking, which loosened the apparatus inside of three or four minutes, after which it was pulled to the shore and stored in a shed.



Two variations of the motor-whip game are shown above. Fig. 2 consists in circling a marked post before heading towards the goal, and Fig. 4, in winding a zigzag course in between a number of these poles.

A motor turning over at about 1,800 revolutions per minute is used to supply the power to turn the whip. If the motor is of the gasoline type, it should be rated at about one-half to one horsepower, but an electric motor of one-quarter horsepower will drive it nicely. The rotary motion is imparted to the wheel by gears having a ratio of about fifteen to one. The stand or upright portion is made of two pieces of pipe, one two inches in diameter, and the other three inches. The electric light wires running to the motor are brought in at the top, and led down through the pipe. The whole arrangement is mounted upon a strong plank base about 3 feet square, which has four pegs made of pipe or wood projecting downward, so as to hold the Motor-Whip firmly in the ice.

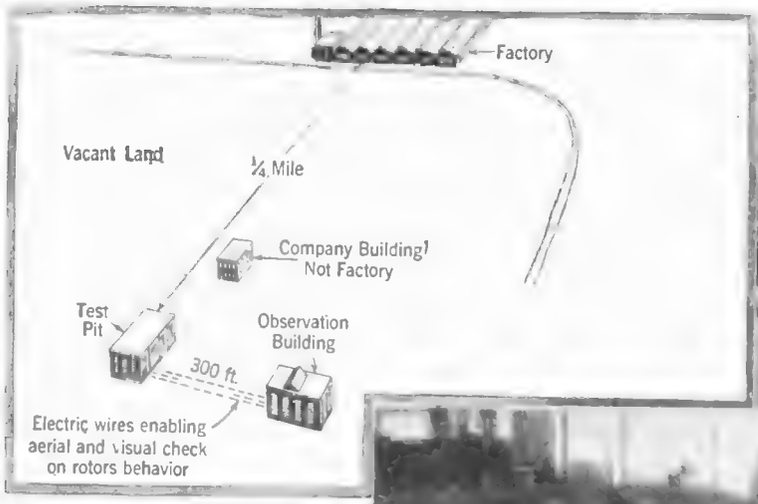
The illustrations show various ways in which the wheel can be constructed, a belt pulley about two feet in diameter, with a cross of wood bolted firmly to it, may be used as the wheel. If an old wagon wheel is handy, this will serve admirably for this purpose. The wheel can also be made of one and a quarter inch pipe, as shown. Hand grips are arranged at intervals around its circumference, for the convenience of the skaters. A method of tightening or loosening the belt's drive should be employed, several suggestions of which are given in the illustration. The wheel revolves at a speed of about 2 revolutions per second or 120 per minute, so that the sport is not dangerous.

The skater holds on to the wheel for one complete turn, and at a certain point he releases his hold, flying off at a tangent. A goal is arranged at a distance from the wheel and the skater must reach this goal without moving his feet to assist the propulsion speed which was given him by the wheel. The distance traversed will be determined entirely by his skill in skating and a number of other factors such as the sharpness of the skates, the wind resistance and the like. The sport, of course, can be greatly varied. One idea is to place an obstacle post in the pathway to the goal which the skater must encircle before continuing on his way to the finish line. A number of these posts may be arranged in a line, the object being for the skater to wind his way in and out between these until he reaches the goal. A variation of the sport, which can be carried out with the goal post alone, is also shown. This consists in encircling one or both of the goal posts before the finish is reached. A good deal of skill is required before the skater will become proficient in this sport. Throughout the contest the feet are not lifted from the ice, but are held close together in a parallel position.

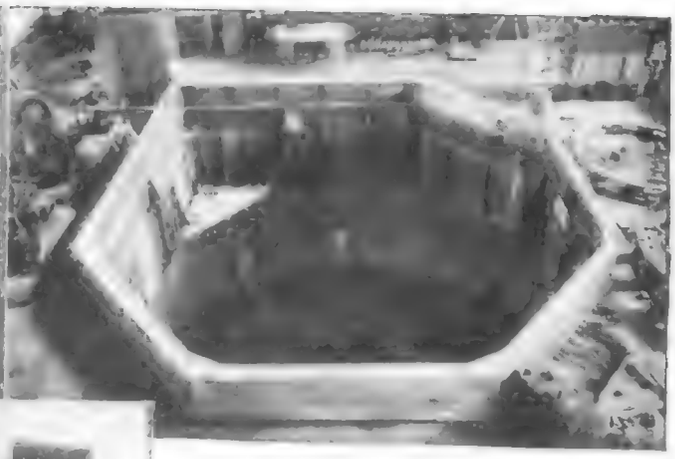
The apparatus can also be equipped with a number of electric lights, so that it can be used at night, giving sufficient illumination for carrying on the sport. The Motor-Whip can be built at a very reasonable cost, and should provide many hours of healthy amusement. Enough data has been given so that anyone who is handy with tools will be able to build the whip. The base upon which the apparatus rests should be solid and be able to stand the strain which is put upon it. Furthermore, it should be anchored in the ice by a number of pegs. The motor switch handle extends both ways above the wheel, but does not revolve. This switch handle operates the motor wheel and can be turned off by the skaters at will, simply by reaching across the wheel in case they desire to start or stop the motor. Electric heating coils may be built inside the pipe pegs, and switched into circuit at the desired time. This will quickly loosen the pegs.

The method of scoring a goal as shown above is probably the most intricate and thrilling of them all. In order to score, the skater must first encircle one of the supports of the goal, as shown in the above illustration, Fig. 3.

Test Machines at High Speed in Pit

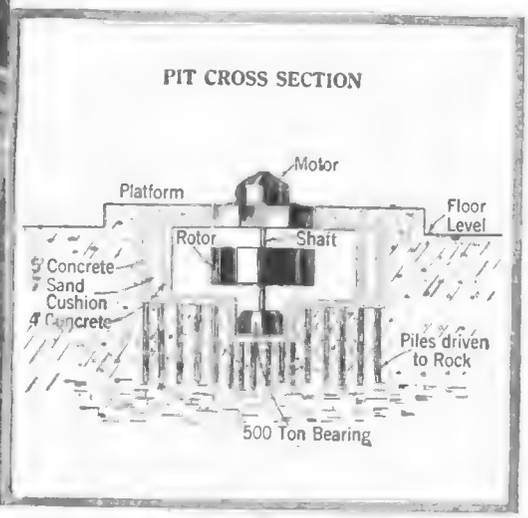


Above we have an illustration showing the situation of the pit, the observation building and the factory. The observation building is situated 300 feet away from the testing pit. The pit itself is one-quarter mile away from the factory.



Above is a photo showing the interior of the huge testing pit. To the left we have another view of the pit, together with the top plate. This plate is 8 feet thick and is made of concrete and steel.

The illustration above shows the old way and the new way of testing large pieces of revolving machinery. The old way of testing was extremely dangerous.



The illustration above shows a cross section of the pit, with most of its salient features.
Courtesy General Electric Co.

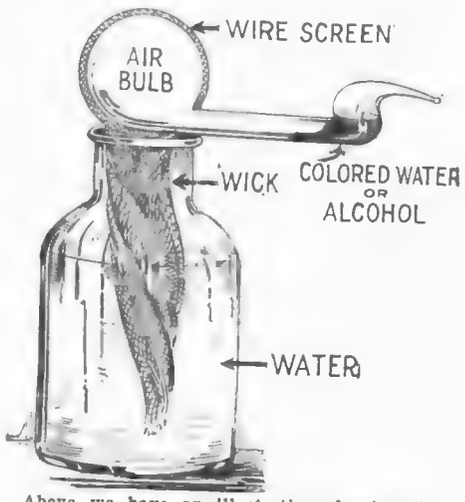
The world's largest testing pit, which permits the testing of large pieces of revolving machinery with safety to the operators, has just been completed by the General Electric Co., at Schenectady, New York. This pit will permit tests which cannot be duplicated anywhere else in the world, at the present time. It will test rotors from the smallest size up to a huge machine 40 feet in diameter, and weighing as much as 500 tons. The pit itself is a circular chamber with a depth of 30 feet. An observation building has been erected 300 feet from the pit. In this building are cables controlling the motors in the pit and means of obtaining either visual or photographic records of the amount of vibration. The testing of high-speed rotors is thus made safe.

Making Bubble Toys

By RAYMOND B. WAILES

At the left we have a photograph of the completed bubble toy. It has a glass tube in its mouth upon which it seems to be sucking merrily at all times.

Bubble toys, resembling a man, a monkey, and the like, with a glass tube in their mouth, upon which they are sucking at all times, may be constructed easily. The details of this novel toy are shown in the illustration. The finished toy can be dressed appropriately. From time to time, the water which evaporates will have to be replaced. This little scientific toy is in reality a hygrometer which shows the amount of moisture in the air. When there is much moisture in the air the water will not evaporate from the cloth head as fast as it will if the humidity is low, so the drop of liquid would only run up the tube say about 60 times a minute. If the air is dry, the drop will move faster.

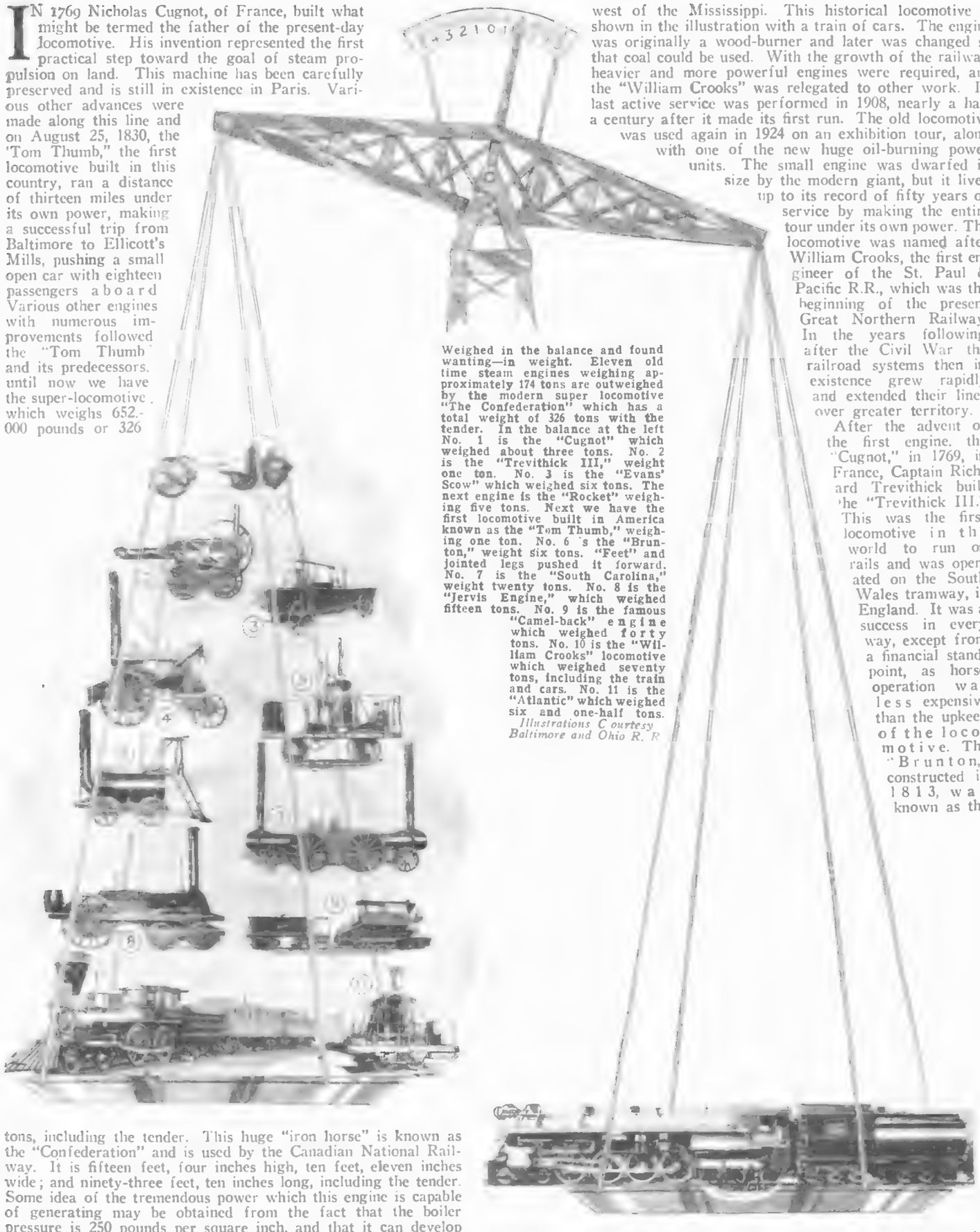


Above we have an illustration showing the details of construction of the bubble toy.

Locomotives----Old and New

One Modern Locomotive Weighs Almost Twice as Much as Eleven "Old Timers"

IN 1769 Nicholas Cugnot, of France, built what might be termed the father of the present-day locomotive. His invention represented the first practical step toward the goal of steam propulsion on land. This machine has been carefully preserved and is still in existence in Paris. Various other advances were made along this line and on August 25, 1830, the 'Tom Thumb," the first locomotive built in this country, ran a distance of thirteen miles under its own power, making a successful trip from Baltimore to Ellicott's Mills, pushing a small open car with eighteen passengers aboard Various other engines with numerous improvements followed the "Tom Thumb" and its predecessors. until now we have the super-locomotive. which weighs 652.-000 pounds or 326 tons, including the tender. This huge "iron horse" is known as the "Confederation" and is used by the Canadian National Railway. It is fifteen feet, four inches high, ten feet, eleven inches wide; and ninety-three feet, ten inches long, including the tender. Some idea of the tremendous power which this engine is capable of generating may be obtained from the fact that the boiler pressure is 250 pounds per square inch, and that it can develop more than 3,200 horsepower. The next largest locomotive to this is the "President Washington," which weighs 270 tons, including the tender. The little "William Crooks," built in 1861 by Smith & Jackson, of Paterson, N. J., was the first engine to pull a train west of the Mississippi. This historical locomotive is shown in the illustration with a train of cars. The engine was originally a wood-burner and later was changed so that coal could be used. With the growth of the railway, heavier and more powerful engines were required, and the "William Crooks" was relegated to other work. Its last active service was performed in 1908, nearly a half a century after it made its first run. The old locomotive was used again in 1924 on an exhibition tour, along with one of the new huge oil-burning power units. The small engine was dwarfed in size by the modern giant, but it lived up to its record of fifty years of service by making the entire tour under its own power. The locomotive was named after William Crooks, the first engineer of the St. Paul & Pacific R.R., which was the beginning of the present Great Northern Railway. In the years following after the Civil War the railroad systems then in existence grew rapidly and extended their lines over greater territory.



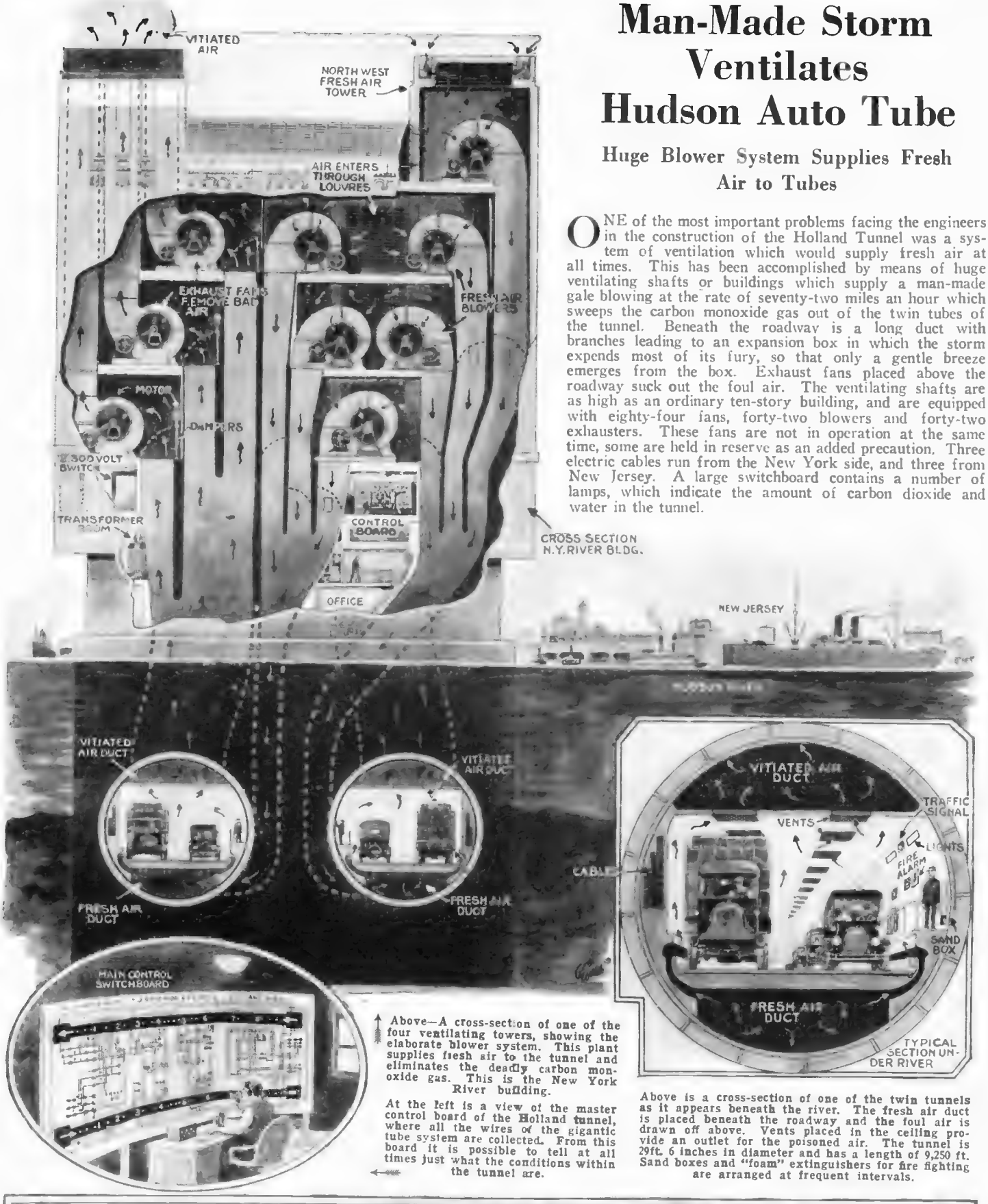
Weighed in the balance and found wanting—in weight. Eleven old time steam engines weighing approximately 174 tons are outweighed by the modern super locomotive "The Confederation" which has a total weight of 326 tons with the tender. In the balance at the left No. 1 is the "Cugnot" which weighed about three tons. No. 2 is the "Trevithick III," weight one ton. No. 3 is the "Evans' Scow" which weighed six tons. The next engine is the "Rocket" weighing five tons. Next we have the first locomotive built in America known as the "Tom Thumb," weighing one ton. No. 6 is the "Brunton," weight six tons. "Feet" and jointed legs pushed it forward. No. 7 is the "South Carolina," weight twenty tons. No. 8 is the "Jervis Engine," which weighed fifteen tons. No. 9 is the famous "Camel-back" engine which weighed forty tons. No. 10 is the "William Crooks" locomotive which weighed seventy tons, including the train and cars. No. 11 is the "Atlantic" which weighed six and one-half tons. *Illustrations Courtesy Baltimore and Ohio R. R*

After the advent of the first engine. the "Cugnot," in 1769, in France, Captain Richard Trevithick built the "Trevithick III." This was the first locomotive in the world to run on rails and was operated on the South Wales tramway, in England. It was a success in every way, except from a financial standpoint, as horse operation was less expensive than the upkeep of the locomotive. The "Brunton," constructed in 1813, was known as the "horse-leg locomotive" and was one of the oldest of all the early types. The "Brunton" was operated by a mechanism which alternately caused one of a pair of very long legs and "feet" to push the engine forward. It lost out, due to its slow speed of 3 miles per hour.

Man-Made Storm Ventilates Hudson Auto Tube

Huge Blower System Supplies Fresh Air to Tubes

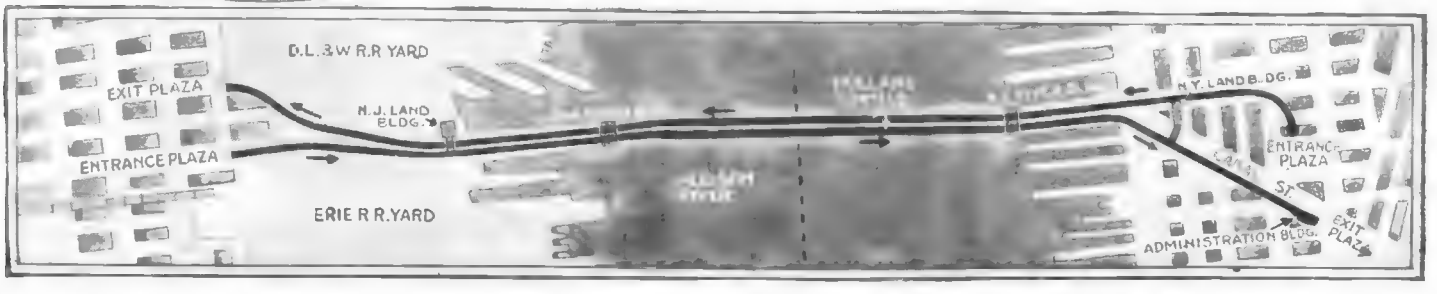
ONE of the most important problems facing the engineers in the construction of the Holland Tunnel was a system of ventilation which would supply fresh air at all times. This has been accomplished by means of huge ventilating shafts or buildings which supply a man-made gale blowing at the rate of seventy-two miles an hour which sweeps the carbon monoxide gas out of the twin tubes of the tunnel. Beneath the roadway is a long duct with branches leading to an expansion box in which the storm expends most of its fury, so that only a gentle breeze emerges from the box. Exhaust fans placed above the roadway suck out the foul air. The ventilating shafts are as high as an ordinary ten-story building, and are equipped with eighty-four fans, forty-two blowers and forty-two exhausters. These fans are not in operation at the same time, some are held in reserve as an added precaution. Three electric cables run from the New York side, and three from New Jersey. A large switchboard contains a number of lamps, which indicate the amount of carbon dioxide and water in the tunnel.



Above—A cross-section of one of the four ventilating towers, showing the elaborate blower system. This plant supplies fresh air to the tunnel and eliminates the deadly carbon monoxide gas. This is the New York River building.

At the left is a view of the master control board of the Holland tunnel, where all the wires of the gigantic tube system are collected. From this board it is possible to tell at all times just what the conditions within the tunnel are.

Above is a cross-section of one of the twin tunnels as it appears beneath the river. The fresh air duct is placed beneath the roadway and the foul air is drawn off above. Vents placed in the ceiling provide an outlet for the poisoned air. The tunnel is 29ft. 6 inches in diameter and has a length of 9,250 ft. Sand boxes and "foam" extinguishers for fire fighting are arranged at frequent intervals.



The above drawing shows the exact location of the Holland Tunnel and the exit and entrance plazas on both sides of the river.

Pendulum Locates Oil Deposits

By S. R. WINTERS

Variations Caused in Pendulum Swing by Gravity Changes Occasioned by Presence of Oil

A PENDULUM may qualify as the modern divining rod in searching for oil and precious minerals below the surface of the earth. Unlike the twig of hazel or willow, which is supposed to exercise magic in discovering the presence of hidden wealth, the gravity pendulum gives promise of revealing the locations of rich oil fields in accordance with a well-founded scientific principle.

Dr. William Bowie, Chief of the Division of Geodesy of the United States Coast and Geodetic Survey and President of the Section of Geodesy of the International Geodetic and Geophysical Union, is convinced that there is a well-defined relation between the gravity or pull of the earth and the density of the material under the earth's crust. Therefore, a gravity pendulum can be used in determining these variations in the earth's pull and, to that extent, serve as an index to the density or thickness of the under-surface strata and possible presence of oil-bearing rock.

A large oil company is now employing a pendulum, similar to that used by the Coast and Geodetic Survey, in its search for new oil fields. Dr. E. A. Eckhardt, a distinguished scientist, resigned his position as Chief of the Sound Section of the Bureau of Standards, to become identified with a large western oil company whose search for petroleum involves the use of a gravity pendulum or similar device. Investigations by the Coast and Geodetic Survey at 300 gravity stations indicate that there is a definite relation between the earth's pull or gravity and the density of the material of the earth's crust.

The modern divining rod for making an X-ray of the bowels of the earth consists of a pendulum one-fourth of a meter long. This functions in an air-tight case in which, during the observations, the air pressure is reduced to 60 millimeters of mercury. The pendulum swings freely and the impulse which gives it momentum is one's hand, which pushes aside the pendulum bob 4 millimeters from the vertical. The plane in the head of the pendulum and the knife-edge on the case are of agate and the former is made with such great precision that the pendulum will swing for 12 hours without ceasing.

The case containing the gravity pendulum is placed on a concrete or stone slab, resting on the ground, or it is set on a concrete floor, if a basement is available in which to make observations. The pendulum is constructed of invar, an alloy that does not contract nor expand when subjected to temperature fluctuations. Formerly, when employing bronze pendulums, it was necessary to use them in a room or vault where temperature conditions were fairly uniform. The oscillations or to and fro movements of the gravity pendulum are compared by the so-called coincidence method with an astronomic chronometer.

Captain Edwin T. Pollock, Superintendent of the United States Naval Observatory, recently stated that radio time signals were being used in locating oil deposits. This statement implied that in employing the gravity pendulum in searching for petroleum the chronometer or timepiece must be rated by local observations on the stars with a telescope or by means of time signals flashed by radio from the Naval Observatory, through the Annapolis or Bellevue radio stations. The period of swing of the pendulum is thus obtained with so great an accuracy as the ten-millionth part of a second.

"The method employed by the Coast and Geodetic Survey," explains Dr. Bowie, "for the determination of gravity is called the relative method. The pendulum is swung at the base station in the office of the Coast and Geodetic Survey, in Washington, and again at the field station. The determination of the difference in the times required for one oscillation at each of the two places makes it possible to determine the difference in gravity between the two points. The observations are usually continued for two days, in order to get checked measures of the value of gravity.

"The process by which one would attempt to apply the gravity pendulums in the search for petroleum-bearing materials would be to observe gravity first at a number of points over a proved field. From these observations one could determine whether the small differences in density of the material below the surface caused a change in the gravity values. If so, the information thus obtained could be used in prospecting a new field and if abnormal values of gravity were found at the various stations some idea of the subsurface structure could be obtained.

"I do not feel that a definite prediction can be made that the gravity pendulum can be used to detect salt domes or oil-indicating rocks, but I am positive that the larger substructural features can be outlined by the gravity pendulum. I am of the opinion that the gravity pendulum should be thoroughly tested, as is now being done by one of the large oil companies, in order to learn whether or not new methods can be developed in searching for petroleum.

"At least, it would appear worth while to make a gravity survey over a large area where there is a possibility of oil to learn whether the subsurface structure is indicated as clearly as seems possible, judging from the gravity results so far obtained in the

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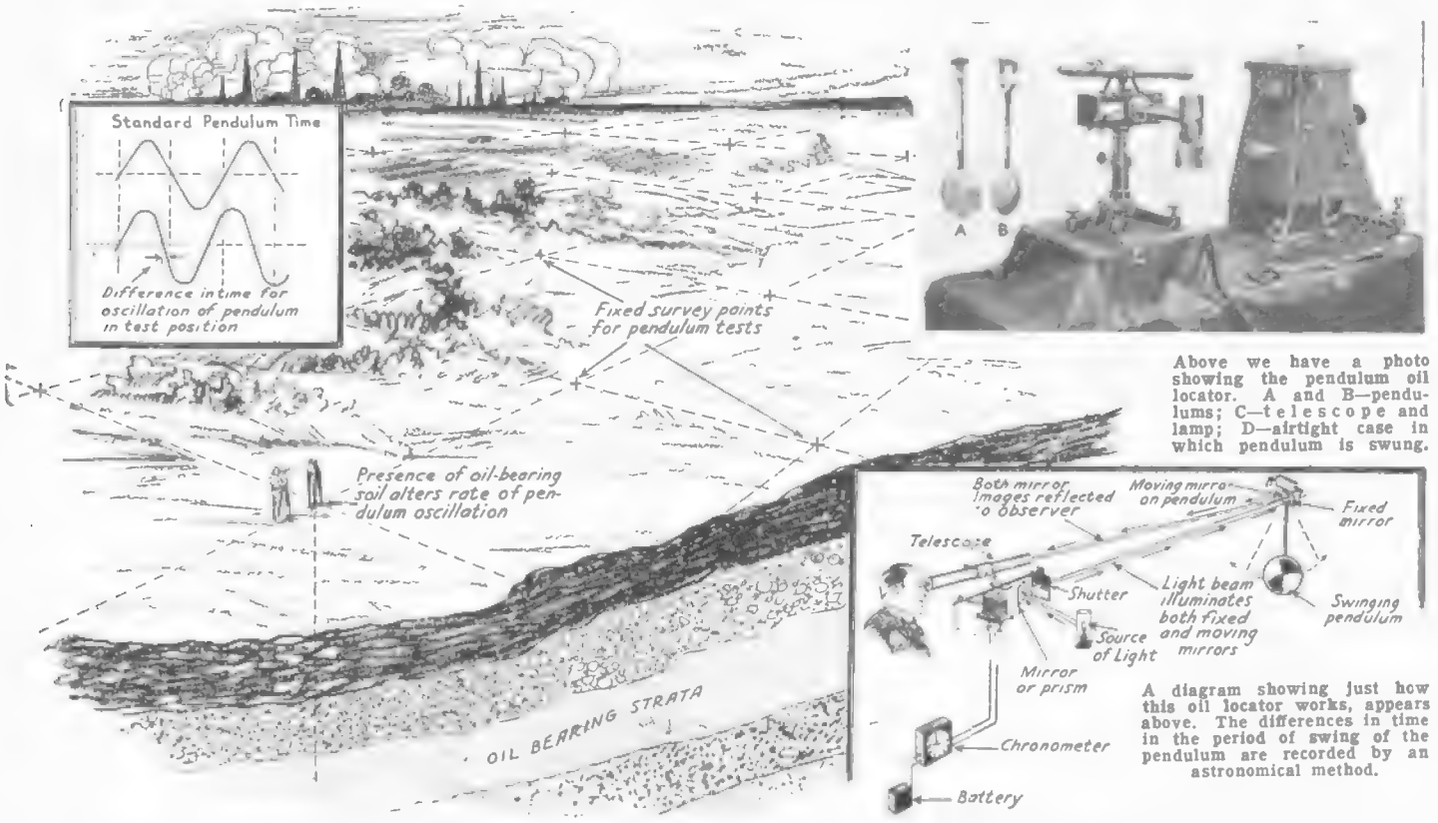


Above we have a photo showing the pendulum oil locator. A and B—pendulums; C—telescope and lamp; D—airtight case in which pendulum is swung.

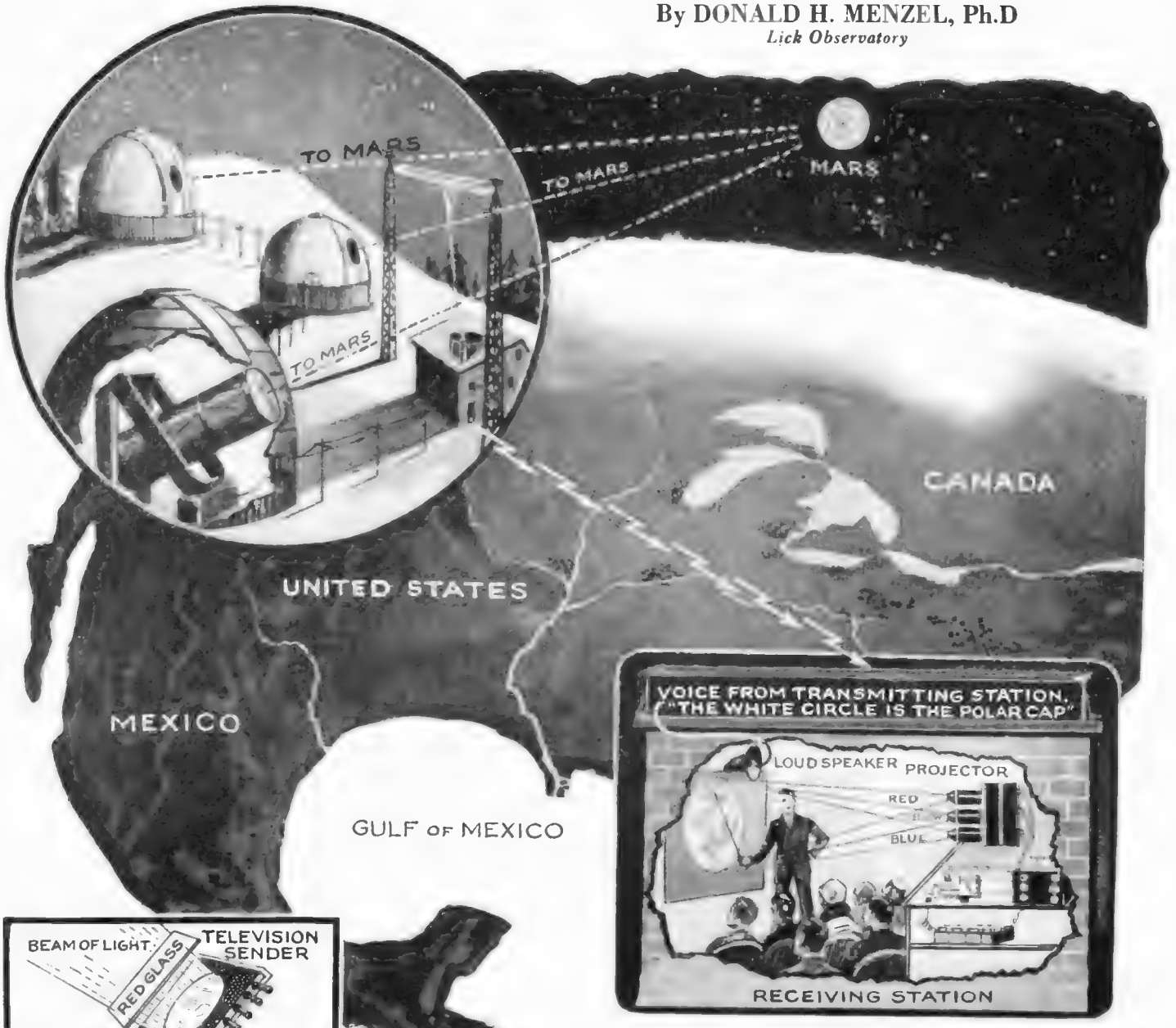
A diagram showing just how this oil locator works, appears above. The differences in time in the period of swing of the pendulum are recorded by an astronomical method.

A number of test points are fixed over a proven field as shown above. The oil-locating pendulum is then placed on each one of these spots, and the presence of oil-bearing strata alters the rate of oscillation.

Television May Solve Star Secrets

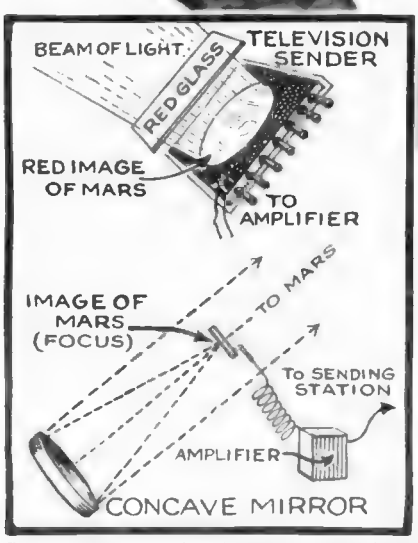
Color Images of Planets Can Be Broadcast from Observatories and Flashed on Screen at Distant Point

By DONALD H. MENZEL, Ph.D
Lick Observatory



In the upper portion of the drawing, we see the observatory with its battery of telescopes which transmit the television images. These images will be explained by radio messages sent out from the observatory.

The above drawing shows the receiving station and the color projector, which throws the actual image upon the screen.



The details of the telescope and television transmitter are shown in the above illustration.

SOME time ago, it was remarked that the extreme sensitivity and amplifying powers of the vacuum tube would find an application in astronomy. With the advent of practical television looming not so far off in the distance, this possibility is rapidly increasing. The device pictured here will probably be developed soon, and within the space of a few years may be in actual use.

The advantage of the telescope over the eye lies in the greater amount of light it collects. An image of the object observed is formed in the focus of the lens or concave mirror. This is magnified by an ordinary lens placed just back of the focal point, the magnification being controlled by the size of the lens. While it is possible theoretically to obtain any desired magnifying power, the practical limitation is imposed by the fact that too high powers make so faint an image that they cannot be seen. Television will make it possible to receive the image upon the sensitive cell of the sending apparatus, amplify the impulses and magnify them greatly upon reception, thus permitting a more comfortable, detailed study of the object. It is even possible that a battery of telescopes, trained on the same body, may be utilized. If red, yellow, and blue filters, respectively, be placed in front of the image in three telescopes, thus forming colored views of the planet or stars under consideration, then the three separate pictures can be combined into one in the receiving set. The single image, resulting from superposition of three, will present the object in practically its natural colors; in fact, the principle involved is quite well known and is employed as the basis of three-color printing. It is not too much to hope for the future broadcasting of an illustrated astronomical lecture directly from the telescope, thus bringing the inaccessible observatory from its mountain top, far from civilization, into the home or lecture room of the city. The illustration here shows the observatory of the future, with its triple telescopic battery pointed at Mars. The tri-color images, together with a description, are broadcast from the observatory.

The Flying Piano

Latest Stage Novelty Mystifies New York Audience

By H. WINFIELD SECOR

IN the flying piano act, the instrument was suspended from each corner by ⅜-inch steel cables which passed through eye-bolts fastened to the case. The four cables eventually came together in a ¾-inch steel cable, which was led through the gridiron above the stage, over several pulleys and thence back-stage to a motor winch. This winch wound in or let out the cable, thus regulating the movements of the piano. These movements were further controlled from the fly gallery by a stage hand, who regulated two cables attached to the supporting cables as shown. The stage orchestra was situated upon a moving platform, which further added to the novelty of the performance. A dark back drop was used and all the stage lights, as well as most of the lights in the theatre, were put out. A bank of powerful lights were then directed toward the audience. All these various so-called *stage tricks* prevented the audience from determining just how the piano floated in mid-air, and thus made the act mystifying as well as entertaining. Several small shielded lights were placed above the keyboard of the piano, so that the musician could see the keys clearly. This is one of the most successful means of producing a flying or floating effect, but several others have been used previous to this occasion. The following method was used in theatres some years ago, in connection with an aerial singing act. The singer was seated upon the end of a steel boom, supported by a steel cable which passed through a pulley and thence back-stage. A black velvet drop was used and the steel boom passed through this so that its movements could be regulated by the stage hands. The velvet back drop was slit in the center, allowing for the insertion of the boom. A spotlight was thrown directly upon the singer. A counterweight could also be employed, and in some cases was fastened to

(*Continued on page* 933)

NEW YORK'S latest stage sensation was recently exhibited at a well-known theatre. The audience was astounded when a piano gently rose from the stage and sailed into mid-air, as gracefully as some huge white bird. During the flying episode a young woman rendered various piano selections. This may seem a strange and thrilling feat when viewed from the audience, but if one goes back-stage as our artist did, this seemingly impossible act is readily explained as shown in the illustration. By the skillful arrangement of the lights the steel cables supporting the piano could not be discerned and did not contrast with the dark back drop which was used. Powerful lights were directed toward the audience and the remainder of the theatre was plunged in almost total darkness. Another novelty used in conjunction with this remarkable act was the moving platform upon which the stage orchestra was seated. During the act the footlights were extinguished and a bank of small shielded lamps, which were placed above the keyboard of the piano, were lighted.

The illustration above shows the method of obtaining a flying effect as used in some theatres.

The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

CHAPTER XV.

"FREE! BUT A MONSTER!" (Fifth Installment)

THE peculiar ability of the human mind to slip so readily into the refuge of the commonplace after or even during some well-nigh intolerable crisis has long been to me one of the most interesting phenomena of our psychology. It is instinctive, of course; a habit acquired through precisely the same causes that have given to the animals their protective coloration—the stripes, say, of the zebra and tiger that blend so cunningly with the barred and speckled shadowings of bush and jungle, the twig and leaflike shapes and hues of certain insects; in fact, all that natural camouflage which was the basis of the art of concealment so astonishingly developed in the late war.

Like the animals of the wild, the mind of man moves through a jungle—the jungle of life, passing along paths beaten out by the thought of his countless forefathers in their progress from birth to death. And these paths are bordered and screened, figuratively and literally, with bush and trees of his own selection, setting out and cultivation—shelters of the familiar, the habitual, the customary. On these ancestral paths, within these barriers of usage, man moves hidden and secure as the animals in their haunts—or so he thinks.

Outside them lie the wildernesses and the gardens of the unknown, and man's little trails are but rabbit runs in an illimitable forest. But they are home to him.

Therefore it is that he scurries from some open place or revelation, some storm of emotion, some strength-testing struggle, back into the shelter of the obvious, finding in it a familiar environment that demands no slightest expenditure of mental energy or initiative, and gaining fresh strength to sally forth again into the unfamiliar.

I crave pardon for this digression. I set it down because I remember how when Drake at last broke the silence that had closed in upon the passing of that still, small voice the essence of these thoughts occurred to me.

Determinedly he strode over to the weeping girl, and in his tones was a roughness that angered me until I realized his purpose.

"Get up, Ruth!" he ordered. "He's come back once, so he'll come back again. Now let him be and help us get a meal together. I'm hungry."

She looked up at him, incredulously, indignation rising.

"Eat!" she exclaimed. "You can be hungry!"

"You bet I can—and I am," he answered cheerfully. "Come on; we've got to make the best of it."

"Ruth," I broke in, gently, "we'll all have to think about ourselves a little if we're to be of any use to him. You must eat—and then rest."

"No use crying in the milk even if it's spilt," observed Drake, even more cheerfully. "I learned that at the front where we got so we'd yelp for the food even when the lads who'd been bringing it were all mixed up in it."

She lifted Ventnor's head from her lap and rested it on the silks. She arose, eyes wrathful, her hands clenched as though to strike Drake.

"Oh—you brute!" she whispered. "And I thought—I thought—Oh, I hate you!"

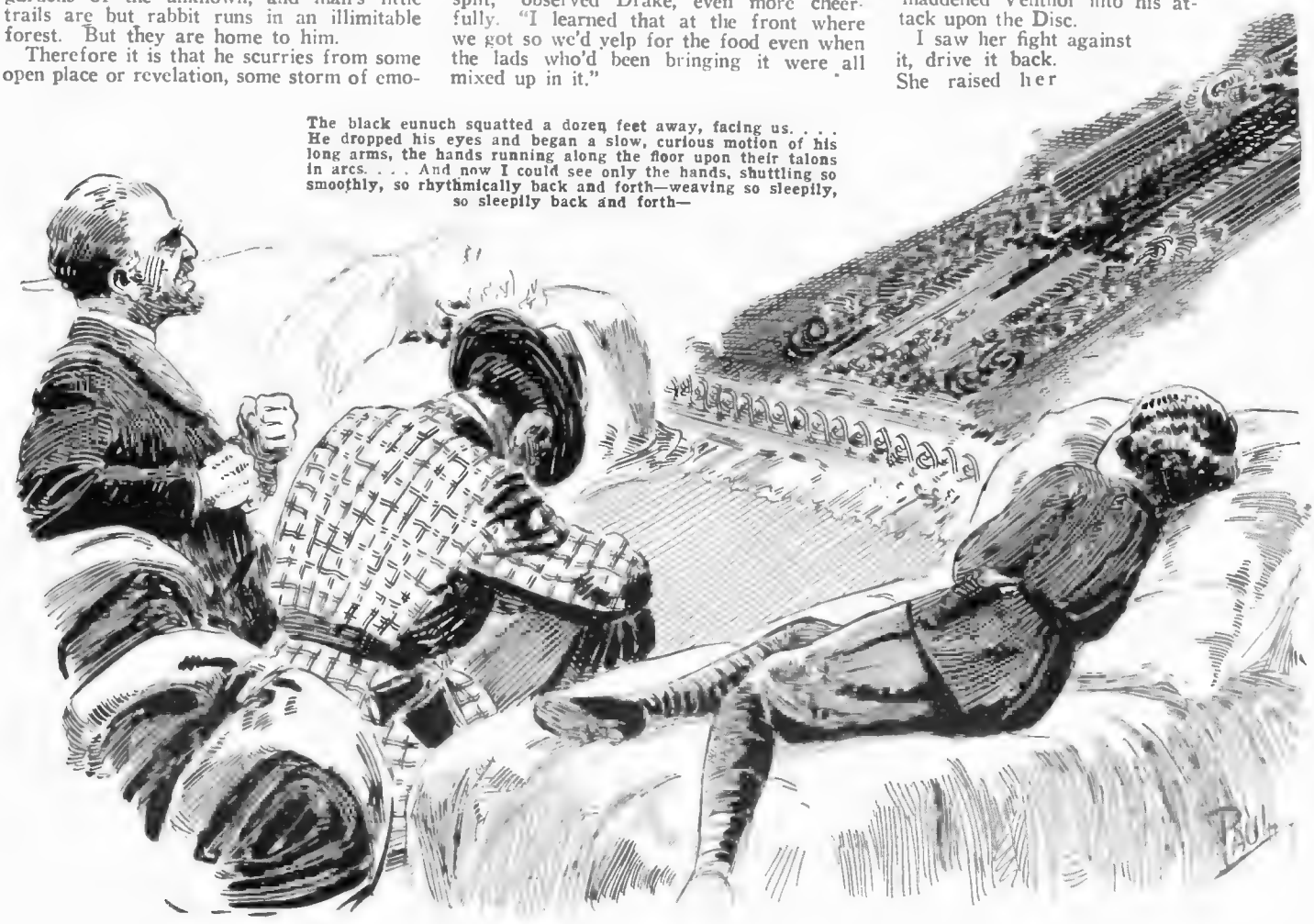
"That's better," said Drake, and smiled upon her. "Go ahead and hit me if you want. The madder you get, the better you'll feel."

For a moment I thought she was going to take him at his word, then her anger fled.

"Thanks—Dick," she said quietly; and while I sat studying Ventnor, they put together a meal from the stores, brewed tea over the spirit-lamp with water from the bubbling spring, and in these commonplaces I knew that she at least was finding relief from that strain of the abnormal under which we had labored so long. To my surprise I found that I was hungry, and with deep relief I watched Ruth partake of food and drink even though lightly.

About her seemed to hover something of the ethereal, elusive and disquieting. Was it the pellucid light that gave the effect, I wondered. And knew it was not; for as I observed her, covertly, I recognized upon her face that shadow of inhuman tranquility, of unearthly withdrawal which, I guessed, had more than anything else maddened Ventnor into his attack upon the Disc.

I saw her fight against it, drive it back. She raised her



The black eunuch squatted a dozen feet away, facing us. . . . He dropped his eyes and began a slow, curious motion of his long arms, the hands running along the floor upon their talons in arcs. . . . And now I could see only the hands, shuttling so smoothly, so rhythmically back and forth—weaving so sleepily, so sleepily back and forth—

head, and met my gaze. In her eyes I read both terror and shame. It came to me that, painful as it might be for her, the time for questioning had come.

"Ruth," I said, "I know it's not necessary to remind you that we're in a tight place. Every fact and every scrap of knowledge that we can lay hold of is of the utmost importance in enabling us to determine our course. I'm going to repeat your brother's question—what did Norhala do to you? What happened to you when you were floating before the disc?"

"There was nothing," she whispered—then defiantly—"nothing! I don't know what you mean!"

"Ruth!" I spoke sharply now. "You do know. You must tell us—if not for our sake, then for his." And I pointed toward Ventnor.

She drew a long breath.

"You're right—of course," she said, unsteadily. "Only I—I thought maybe I could fight it out myself. But you must know—there's a—a taint upon me!"

"A taint!" I cried, and caught in Drake's swift glance the echo of my own thrill of apprehension for her sanity.

"Yes," she said, quietly. "A taint. Some new and alien thing within my heart, my brain, my soul. Something that first came to me from Norhala when we rode the flying block together, and that—it—sealed upon me when I was in—It's . . ." she crimsoned, and whispered—"embrace. A thing that urges me to forget you two—and Martin—and all the world I've known; that tries to pull me from you—from all—to drift untroubled in some vast calm filled with an ordered ecstasy of peace. And whose calling I want, God help me, oh, so desperately to heed!

"It whispered to me first," she went on, breathlessly, "from Norhala—when she put her arm around me. It whispered, and

then it seemed to float from her and cover me like—like a substance, and from head to foot. It was a quietness and peace that held within it a happiness and at one and the same time utterly tranquil and utterly lawless.

"I seemed to be at the threshold of unknown raptures—and the life I had known only a dream—and you, all of you—even Martin, dreams within a dream. You weren't—real—and you did not—matter."

"Hypnotism," muttered Drake, as she paused.

"No." She had heard him and shook her head. "No, more than that. The wonder of it grew—and grew. I thrilled with it. I remembered nothing of that ride, except once when, through the peace enfolding me, there pierced a warning that Martin was in peril, and I broke through to see him clutching Norhala and to see floating up in her eyes—death—for him.

"And I saved him—and again I forgot. Then, when I saw that flaming shape—I felt no terror, no fear—only a tremendous—joyous—anticipation, as though—as though" she faltered, hung her head, then leaving that sentence unfinished, whispered: "And when—it lifted me it was as though I had come at last out of some endless black ocean of despair into the full sun of Paradise!"

"Ruth!" At the shocked wonder in Drake's cry I saw her wince.

"Wait," she held up a tremulous hand. "You asked—and—you must listen."

When once more she spoke her voice was low, curiously rhythmic, her eyes rapt.

"I was free—free of every human fetter of fear or sorrow or love or hate. Free even of hope—for what was there to hope for when everything desirable was mine? And I was elemental, one with the eternal things—yet fully conscious that I was—I!

"Out of what held me, out of the fires within it pulsed life, a flood of life in which I was bathed. And it was as though this life were—reassembling me, fitting me closer to the elemental things, changing me into them.

"Then the shots. Awakening was—dreadful, a struggling back from drowning. I saw Martin—blasted. I drove the—the spell away from me. I tore it away. And, O Louis—Dick—it hurt—it hurt—and for a breath before I ran to him it was like—like coming from a world in which there was no disorder, no sorrow, no doubts, a rhythmic, harmonious world of light and music, into—into a world that was like a black and dirty kitchen.

"And it's still there," her voice rose. "It's still within me—the taint; whispering, whispering; urging me away from you, from Martin, from every human thing; bidding me give myself up, surrender my humanity to—to what?

"Its seal," she sobbed. "Something that strives to make the human in me a slave—that waits to overcome my will—and if I surrender gives me freedom, an incredible freedom—but makes me, being still human, a—monster!"

She hid her face in her hands.

"If I could only sleep," she wailed. "But I'm afraid to sleep. I think I shall never sleep again. For how do I know that if I sleep—it—may not conquer me?"

I caught Drake's eye. He nodded, understanding fully my unspoken question. I slipped my hand down into the medicine case, and brought forth a certain potent and tasteless combination of drugs which I carry invariably upon explorations.

I dropped a little into her cup, and then held it to her lips. Like a child, unthinking, she obeyed the suggestion and drank.

"But I'll not surrender!" Her eyes were tragic. "Never think it! I can win—don't you know I can?"

"Win?" Drake dropped down beside her, drew her toward him. "Of course you'll win. Nine-tenths of what you're thinking now is purely overwrought nerves and weariness. You'll win—and we'll win, never doubt it."

"I don't," she said. "I know it— It will be hard—but I will—I will—win—"

Her eyes closed, her body relaxed. The potion had done its work quickly. We laid her beside Ventnor on the pile of silken

(*Continued on page* 937)

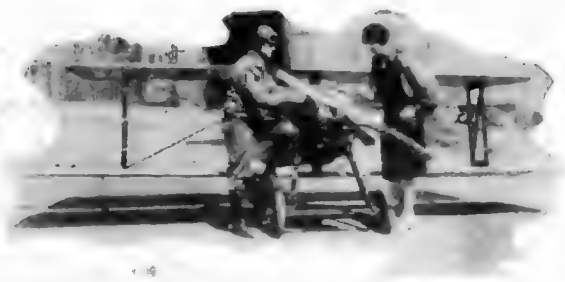
Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming, and two ponies that carried the impedimenta. They came upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate, arriving eventually in the court of the Metal Emperor. Angered by the influence of Norhala over Ruth, Ventnor raises his rifle and fires at the red ruby-like object he believes to be the brain of the metal monster. He is struck down by a lance of green flame and rendered unconscious. The metal monster gives Norhala the entire company to serve as her toys. She takes them to her home, where she informs Yuruk, her ape-like eunuch attendant, they are not to be harmed. Ventnor talks, then lapses into unconsciousness again. Now go on with the story.

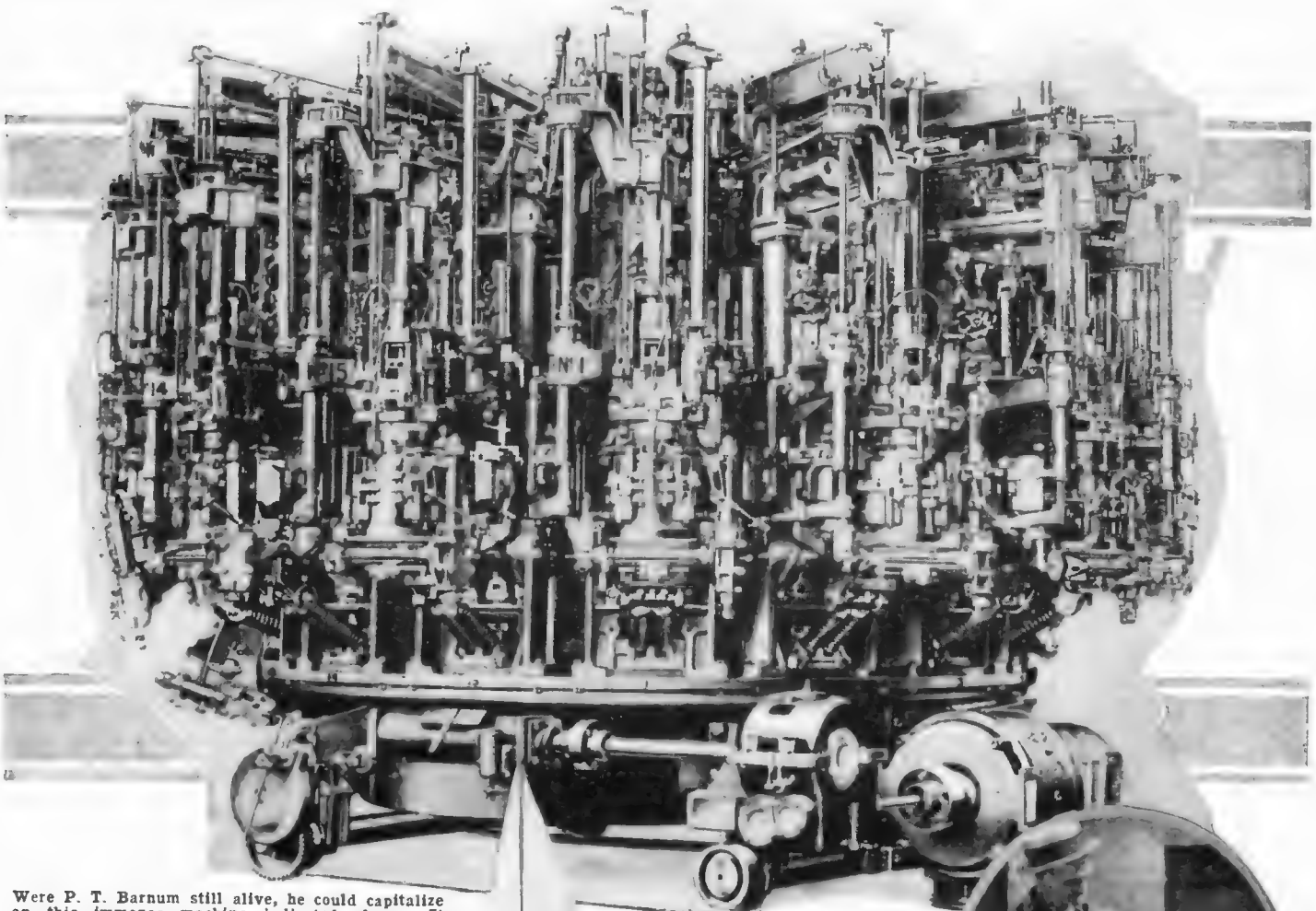
SCIENTIFIC

A Photographic Picturization

The entire world is anxiously watching the progress of aviation. This science is leaping forward so rapidly that it is almost impossible to keep up with its progress. There are advances in the small plane field as well as those in the passenger carrying and freight carrying types. Rapid strides are being taken to eliminate stalling in the air—the latest discovery will be described in the March number.



It looks like a toy, doesn't it, yet this airplane, with a wing span of only 14 feet and powered with a 20-horse-power motor is, without a question, the fastest, smallest plane built. Speed—140 miles per hour, with Jack Erwin piloting.



Were P. T. Barnum still alive, he could capitalize on this immense machine indicated above. It stands about 15 feet high. How would you like to be the mechanic to repair it?

Attempts to graft hair into the head have been varied and numerous. Here is another system slightly different, invented by Prof. Christian Askhaven, of Oslo, Norway, operating on Miss Peggy Tudor. He plants the hair in the scalp by the aid of a fine gold spring which acts as an anchor. It is claimed that the hair remains alive permanently—this is doubtful.

The what-is-it happens to be a new British engineering triumph in the form of a machine for making a million bottles a week. It sure is a formidable looking object.

Axel Bisguard builds boats of newspaper. The newspaper is cut up in the form of strips 1 inch wide and laid on a wooden form, after being wet. After this, layer is glued on layer until a shell containing about 30 thicknesses is formed. The entire shell is then removed from the wood, sandpapered, varnished, shellacked and fitted with deck and sails.

PROGRESS

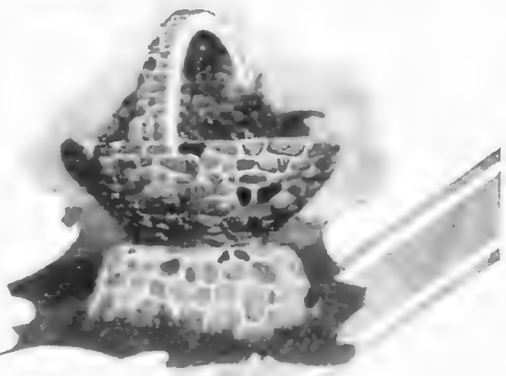
of Modern Scientific Advances

But one must not suppose that the progress in the scientific world is only in the direction of aviation. Everything from garden furniture to baldness cures is receiving its share of well deserved attention. Toys and games are becoming more wonderful and more startling as each new invention is announced, or as the new developments are brought to the attention of the public. Today is indeed a day of progress; perhaps the entire world will move strictly along scientific lines tomorrow. It, therefore, pays the modern student to keep abreast of science because as it develops, so will the student develop.

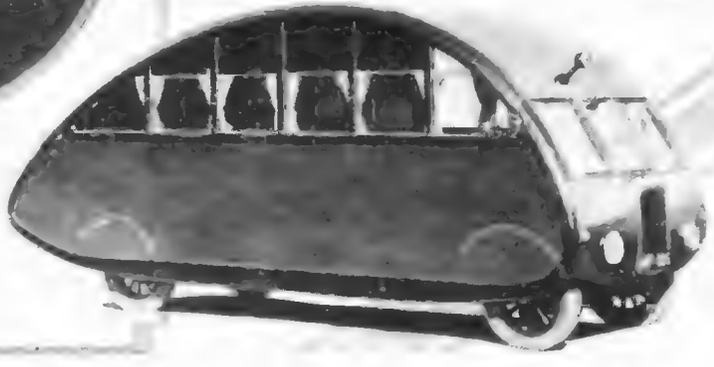
The photo above shows Pierre Chevreau, on the right, explaining his newly-invented landing gear to his pilot, Peuillox. Observe the caterpillar treads. The plane actually took off in recent Paris test flights.

Here is something new and unique in the line of golf courses. It is made almost entirely of pieces of pipe, wood, and bricks, which form the various obstacles.

In the front yard of the Astoria Gas Co., the cameraman discovered the peculiar golf course where the hazards are made of pipes and pipe fittings and loose brick. The course itself is a nine-hole affair, and occupies but very little space. Because of the numerous obstacles, it cannot be covered with but a few strokes and, moreover, requires much skill.



Would you like to do some work in your garden during the winter months? If so, you can start by gathering quite a few choice cobblestones from neighboring hillsides for the construction of this startling yet decorative flower basket.

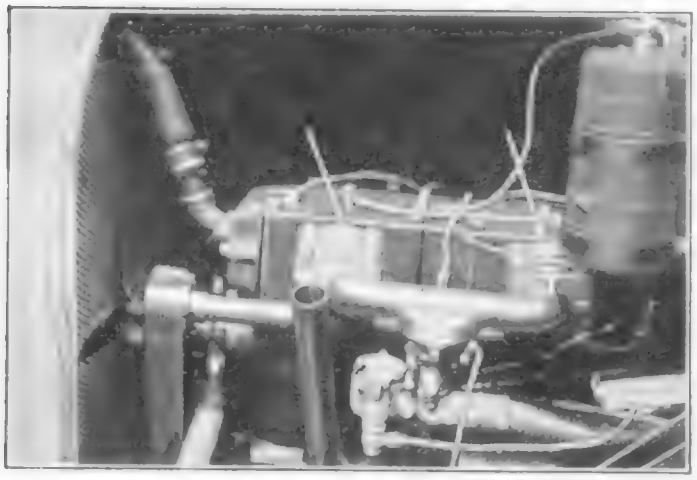


The photo above shows the dining room of the Road Yacht, the newest idea in motoring. This is really a touring house or, had one better say, a palatial yacht on wheels. The driver's seat is not occupied during meals.

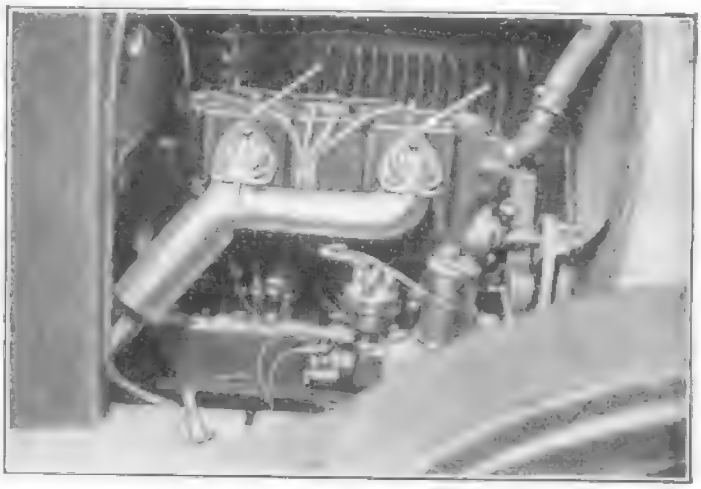
This touring house is fitted with two sleeping cabins, an electric galley, a writing desk, a table, a radio receiver and a phonograph. There are book shelves on the wall and there is a complete lavatory. It will accommodate five people. Its overall length is 18 feet. It is 6 feet 6 inches wide, and the wheel base is 12 feet. A speed of 45 miles per hour is easily obtained over normal roads. Because of its multi-windows, the tourists get an abundance of sunlight. Curtains in back of the windows give them as much privacy as they desire.

New Rotary Valve Auto Engine

Revolutionary Design of Valve for Gasoline Engines May Supplant Present Poppet Type

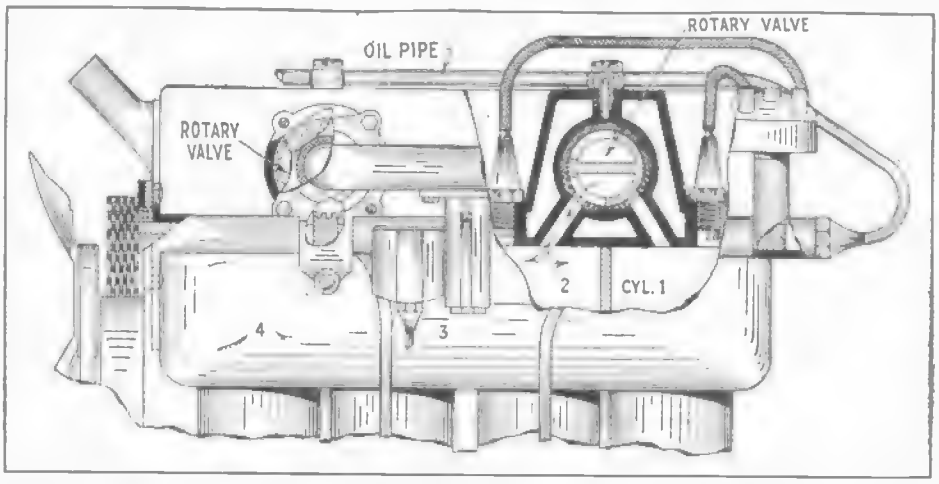


Above we have a photograph of one of the rotary valve engines which was used on a car since May of this year.



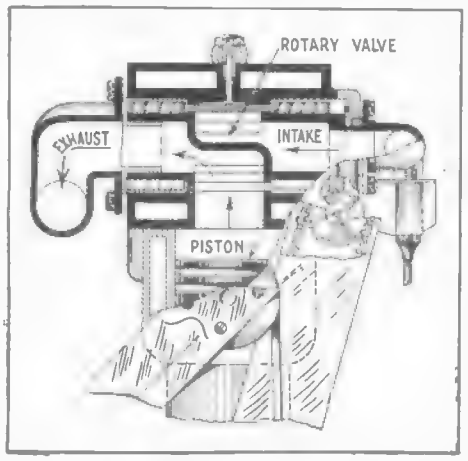
Another view of the new engine appears above. The rotary valve engine shaft revolves at 4,000 revolutions per minute.

A ROTARY valve for internal combustion engines has recently been invented by Joseph F. Mayer, of St. Louis. The engine can be constructed cheaper than those used on the present day motor cars, and will give an increased mileage per gallon of gasoline for automobiles of any description. The three main features of the new motor are: one valve covering two pistons, a shoe which prevents leakage of gas, and a lining of raybestos which is kept continually soaked with oil. This engine turns over at 4,000 revolutions per minute and can be readily applied to any four, six or eight cylinder car. The motor was installed in a small coach and made a run for fourteen hours, with an average speed of 41 miles an hour, covering 28 5/8ths miles on a gallon of gas.



Above we have a drawing showing a view through two of the cylinders. The rotary valve is also shown.

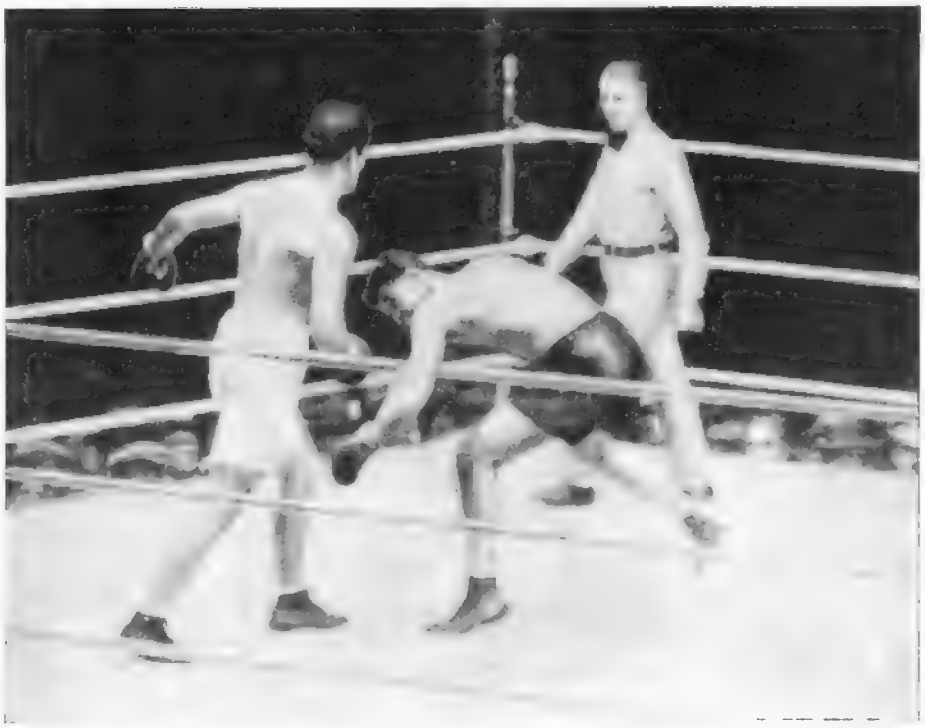
The principal features of the rotary valve motor are an axially rotatable tubular valve for controlling the intake and discharge of a companion pair of cylinders, and a head common to each pair of cylinders. The head has passages leading into the respective cylinders and each passage serves as a common or combined inlet and outlet, to and from its respective cylinder. A unique form and location of packing, obviates any leakage between the valve and cylinders. Engines constructed with the use of this valve are relatively simple in form and structure, durable, reliable and efficient in use and operation, claims the inventor. An enlarged sectional view through a pair of cylinders of an internal combustion engine using the new rotary valve is shown in the drawing appearing here. An enlarged longitudinal sectional view of a valve of the engine is also shown. The new engine may have one or more pairs of cylinders adapted to be fired in a certain sequence. An engine of this type has a single cylinder head in which a pair of rotary valves are located. The head also supports the spark plugs, driving mechanism and other parts. A special packing has been adapted to prevent leakage between the valve and the wall of the bore in which the valve is positioned; thus all parts, with the head, are conveniently removed or detached as a unit whereby easy access may be had to the interior of all the cylinders. This disposition of the several valves and time relation of the firing of the several cylinders are such that one cylinder fires immediately after the other. Passages are arranged so that they serve as common or combined inlet or discharge ports for their respective cylinders and the valve ports. The head ports are so located that when the valve member is rotated, the ports are adapted for registration in turn with the head ports, in proper sequence for the operation of the engine. Within each valve member is a fixed wall, the ends of which are radially disposed in opposite directions and engage the inner face of the wall of the valve. Each valve is thereby provided with discharge and intake chambers, one chamber having a portion diametrically opposed to a corresponding portion of the other. The interval of time between cylinder exhaust and intake has also been reduced to a minimum. The ports are in such relative dimensions that on the rotation of the valve one cylinder is exhausting through one port, while the companion cylinder is intaking through the other.



The drawing above shows an enlarged sectional view of the valve of the engine. The engine using this may comprise one or more pairs of cylinders adapted to be fired in a certain sequence.

The engine as a whole is of comparatively simple structure and of relatively few parts. Besides this it is exceedingly durable and efficient and maintenance costs are reduced to a minimum. The heat imparted to the partition wall by the exhausting gases is used to warm the incoming combustible fluid, thus facilitating its combustion. Roller bearings are suitably interposed in the head for the valves and another bearing is used at the intake end of the valve to take up end thrust. The leakage between the valves and the bearings is prevented by suitable packing. A means is also provided whereby the engagement of the valve seats with the valves is done automatically, suitable to the pressure incident to the engine. A rectangular oblong valve seat and aperture are used. A chain drives the valve shaft.

Glands Make Giants— Not Prizefighters



Over-secretion of the pituitary gland cannot possibly account for the fistic prowess of Jack Dempsey and Gene Tunney, shown in the photograph above as they appeared in their last engagement at Chicago. There are tens of thousands of people who have over-activity of this gland, but there is only one Gene Tunney and one Jack Dempsey. The statement that the glands are responsible for the fighter's ability does not hold true, states Dr. Damrau.

What over-stimulation of the pituitary gland does do, is to produce giants. If over-stimulation occurs after maturity, a condition known as acromegaly is formed. Note the large jaw and separated teeth on John Aasen, who is 8 feet, 9½ inches tall.

By FREDERIC DAMRAU, M. D.

How the Tiny Pituitary Gland, Located in the Skull, May Make You a Giant

EVEN from nursery days, when we eagerly listened to the story of *Jack and the Bean Stalk*, most of us have been interested in giants. Of course we now realize that the terrible monsters of whom we read in our fairy tales never really existed; but history records the cases of authentic giants, and most of us have seen them with our own eyes at the circus.

Frederick the Great had a mania for recruiting enormous men for his personal guard. His crowning glory in this respect was the Scotch giant, who measured 8 feet 3 inches in height. Patrick Cotler, an Irishman who died in 1802, exceeded this record by touching the measure at 8 feet 7 inches. In the Royal College of Surgeons, London, one may see the skeleton of the famous "Irish giant," Charles Byrne, who was 8 feet 4 inches tall.

Chang-woo-goo measured 8 feet 2 inches; Joseph Winkelmaier, 8 feet 9 inches. The tallest man in the world in this time was Machnow, the Russian giant, who stood 9 feet 3 inches when he was exhibited in London in 1905. His hands were 2 feet long, but we do not have accurate figures as to the size of his gloves.

Giantism represents but one of the pranks that the glands of internal secretion may play upon us. What we are mentally and physically—our personalities as well as our bodily peculiarities—depends to a large extent on the activity of these small glands.

THE PITUITARY TYRANT

In the case of the giant, it is the pituitary gland that is responsible. This gland is no larger than a pea, but it controls the growth and development of our bodies in a most tyrannical fashion. And, if we wish to find out why some persons attain such enormous size as to justify being called giants, we must study the function of the pituitary gland.

This little tyrant, the pituitary gland, lies in the interior of the skull, a short distance behind the root of the nose. It is connected by a stalk with the bottom of the brain and lodged in a bony hollow at the base of the skull. If you were to hold in your hand a brain hardened by formalin and beheld the tiny pituitary gland dangling at the end of its flimsy stalk, you would never dream that this unimportant-looking little body plays so large a part in dominating our careers.

There are two parts to the pituitary gland, a front and a rear one. It is only the front, or growth-controlling, portion in which we are interested with reference to the subject of giants. The rear portion has other important functions, principally the secretion of a substance that raises blood pressure and increases the tone of muscles not under control of the will.

How does the pituitary gland act to produce such profound changes in the body? It does not work by way of the stalk connecting it with the brain, as might be concluded at first thought, but by producing definite chemical substances, which it gives off directly into the blood.

The controlling centers of the body have various ways of exacting obedience from the organs. Messages from the brain are responsible for much of this control. This method of regulating the action of organs might be compared with telegraphy. But the glands of internal secretion—and this, of course, applies to the pituitary gland—have an entirely different means of compelling the organs to do their will. They send hormones—or chemical messengers, as they are called—into the blood, and these hormones are rapidly carried to all four corners of the body, as we might say.

The hormone secreted by the *anterior lobe* of the pituitary gland—which is the medical term for the front portion—carries a message for the bones of the body. And that message is, "You must grow!"

When the pituitary gland fails in its duty, the growth of the body is retarded and the bones fail to harden as early as they should. Children with this trouble are usually of the roly-poly type and decidedly backward mentally and sexually. The abnormally inactive pituitary gland may leave a permanent impression on the body's development. The burly thickset individual with the short neck, or almost no neck at all, is frequently one whose pituitary gland has failed him during the growing period.

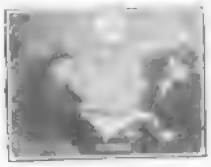
WHAT MAKES A GIANT

Dr. Wilhelm Falta, of Vienna, in his book on *Endocrine Diseases*, reproduces a most impressive X-ray photograph of the skull of a giant. This picture fully shows the importance of the pituitary gland in producing the condition of giantism. The bony chamber in the skull which holds the pituitary gland—called the *sella turcica* because of its resemblance to a Turkish chair—is greatly enlarged, thus indicating that the

(*Continued on page* 932)

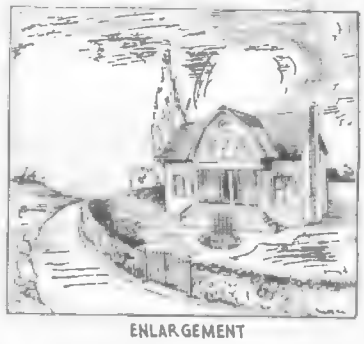
Enlarging Photos by Stretching

The large photograph at the left has been stretched in the manner described here. The original photo from which the enlargement was made is shown below. Note the quality of the enlargement which is undistorted and is as clear as the original photo. The size of the enlargement is alone determined by the thickness of the emulsion and temperature of the water used. Experiments have proven it possible to enlarge a photo to ten times its original size, by means of this simple process. Ordinary plate emulsions yield an enlargement exactly double the size.



At the right we have an illustration showing an original and an enlargement which was made from it. In this case, the photo has been enlarged to ten times its original size.

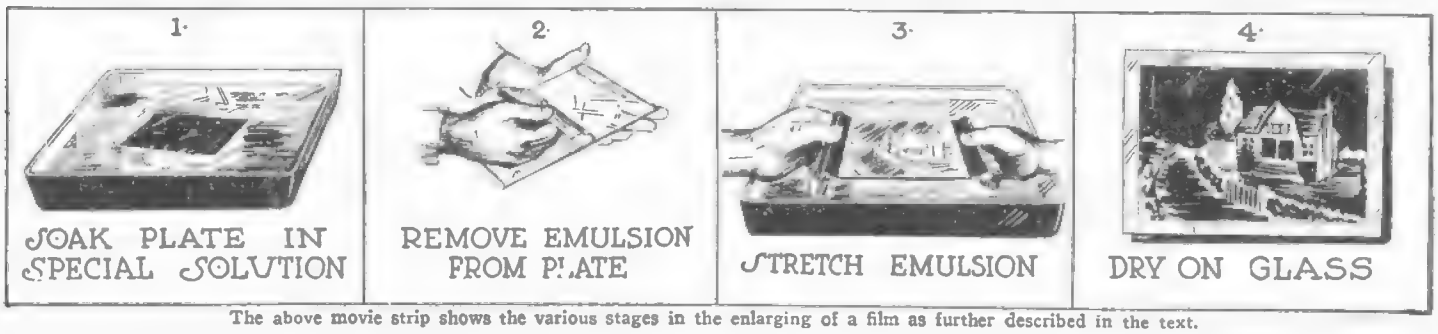
ORIGINAL



ENLARGEMENT

THE new "Kluni" method, called after its inventors, works without any enlarging apparatus. It is independent of any electric connection and workable with the means at the disposal of any amateur photographer, as the enlargement is caused by the stretching of the film itself. The plate, that is to be enlarged, after having been developed in the usual way, is put into a special solution containing, in accordance with an analysis of Professor Dr. A. Junghahn of Berlin, amongst other ingredients 14.01% potassium and 4.96% sodium which consolidate the film by means of a chemical action, at the same time preparing it in such a way as to allow it to be pulled off the plate without any difficulty. After placing the film into water, it can be easily stretched, evenly and in all directions, to such an extent as to fit any size plate desired. When dried, a perfectly enlarged negative of the original photograph is obtained. The desired extent of enlargement is entirely dependent on the thickness of the original film and the temperature of the water used for the stretching solution. The thicker the film and the higher the temperature the greater are the stretching capabilities. Experiments have proven it possible by means of this simple process to enlarge a photo to ten times its size. The exact formula for preparing the solution has not been given.

A. W. Herbert.

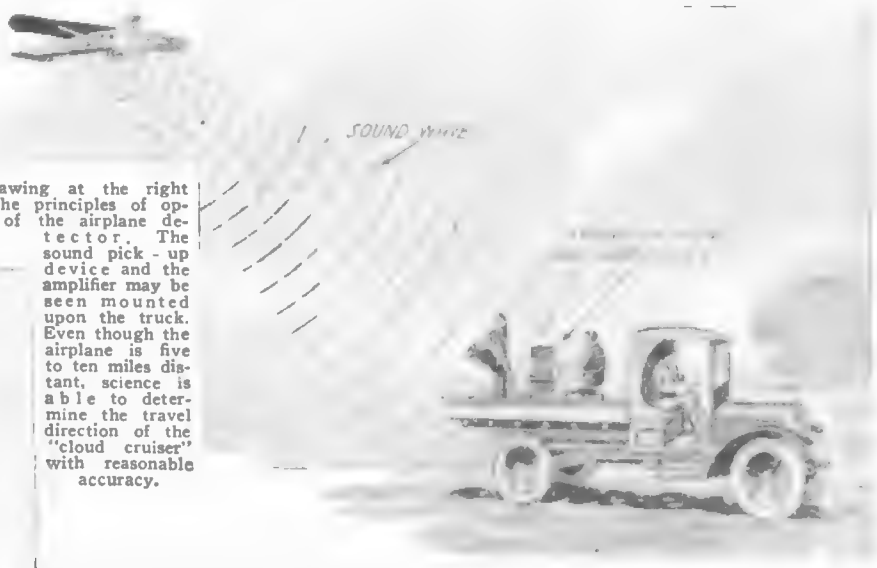


The above movie strip shows the various stages in the enlarging of a film as further described in the text.

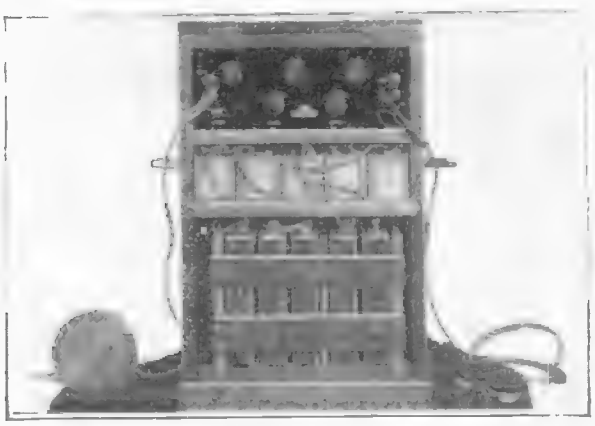
The Radio Airplane "Detective"

A REMARKABLE detector of airplanes has been evolved and perfected recently at the Bureau of Standards. It is an efficient sleuth for the detection of aircraft that are anywhere from five to twenty miles away from the point where the tests are made. The detection is made by means of sound waves, the apparatus which has been developed for that purpose being compact and reasonably simple.

Here in brief, popular language is the way in which the modern detector of airplane presence works. The sound waves from the invisible and far-away aircraft enter a large horn and then pass through an extensive series of small holes drilled in a brass plate. A very sensitive aluminum diaphragm is placed a short distance behind this plate. An ordinary set of radio ear phones is used to increase the audibility of these vastly magnified sounds. This efficient apparatus has been used successfully in detecting sounds from an airplane in flight from eighteen to twenty miles away—and it is a simple matter to distinguish these particular sounds.



The drawing at the right shows the principles of operation of the airplane detector. The sound pick-up device and the amplifier may be seen mounted upon the truck. Even though the airplane is five to ten miles distant, science is able to determine the travel direction of the "cloud cruiser" with reasonable accuracy.



Above is a general view of the receiver used to detect airplanes by sound waves which has been developed by the Bureau of Standards.

The sound waves, speeding with the rapidity at which sound travels, eventually reach the device and set in vibration the aluminum diaphragm. These vibrations are transformed into amplified sound waves by vacuum tubes.

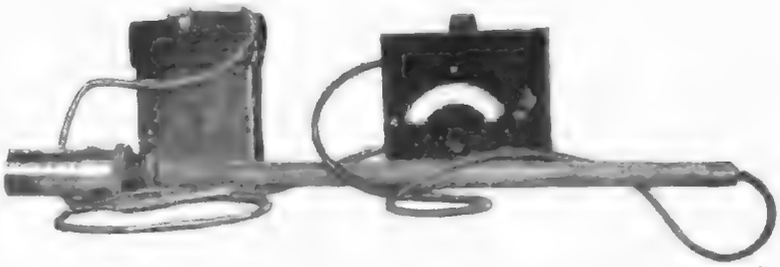
If the airplane is in operation only five to ten miles away, its direction can be determined.

Gas Detector for Miners

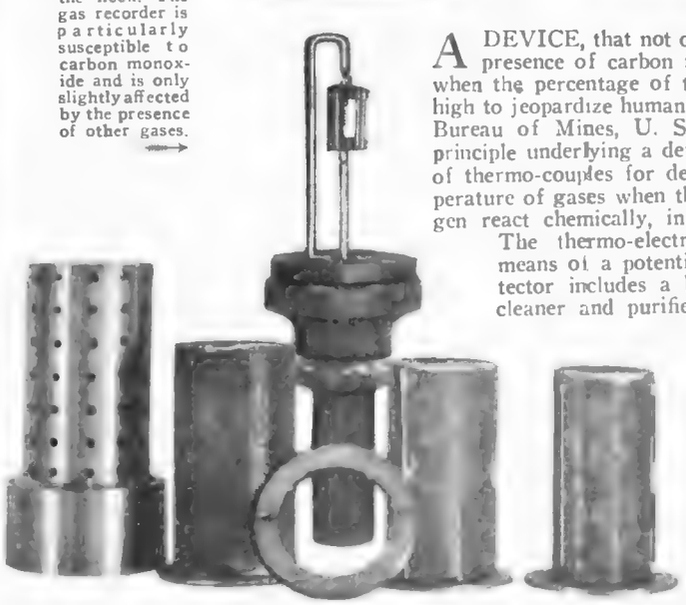
By S. R. WINTERS

Above we see a new gas recorder being used in a mine. Sensitive to 1 part in 1,000,000, a gas recorder has practical possibilities in coal mines, vehicular tunnels, garages and other enclosures where the health and safety of persons may be endangered by poisonous gases. A gas recorder of this nature should be serviceable in promoting economy in boiler furnaces, blast furnaces and other metallurgical and chemical equipment and for prosecuting investigations relating to them.

At the right is a view of a new gas detector which has recently been perfected at the U. S. Bureau of Mines. The long tube is held in the hand and the other apparatus is worn suspended around the neck. The gas recorder is particularly susceptible to carbon monoxide and is only slightly affected by the presence of other gases. →

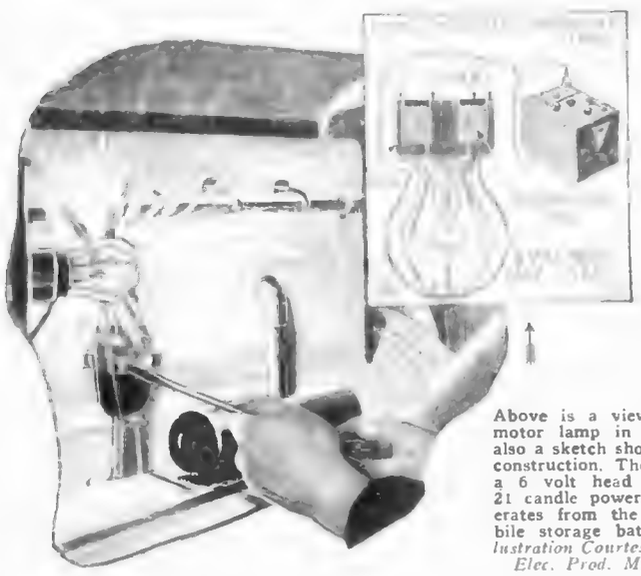


A DEVICE, that not only automatically records the presence of carbon monoxide, but gives warning when the percentage of this deadly gas is sufficiently high to jeopardize human life, has been invented at the Bureau of Mines, U. S. Dept. of Commerce. The principle underlying a device of this nature is the use of thermo-couples for determining the increased temperature of gases when the carbon monoxide and oxygen react chemically, in the presence of a catalyst. The thermo-electric effects are recorded by means of a potentiometer. A complete gas detector includes a blower for the gases, a gas cleaner and purifier and caustic soda material.



The various parts which are used in the construction of a gas detector are shown at the left. The reaction of this apparatus to a death-dealing gas is based on the thermo-electric effect in different thermo-couples when air, containing carbon monoxide, is passed through a catalyst surrounding the hot junctions of the thermo-couples. This device records carbon monoxide.

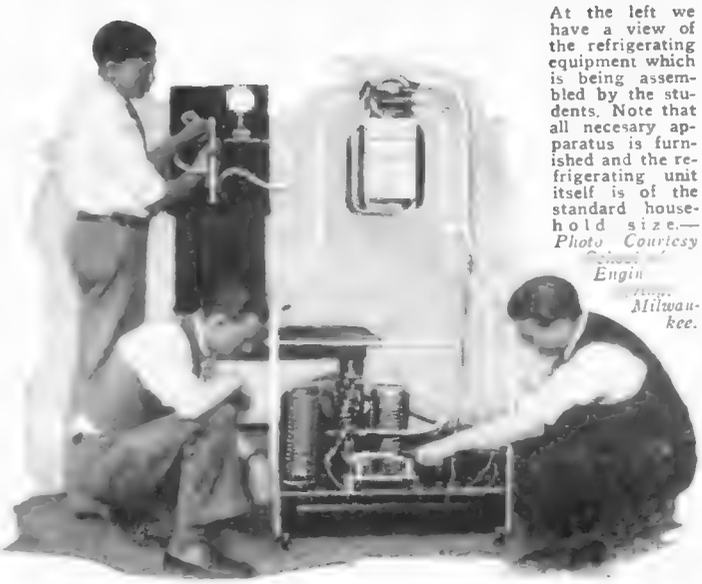
Handy Motor Lamp



Above is a view of the motor lamp in use and also a sketch showing the construction. The bulb is a 6 volt head lamp of 21 candle power and operates from the automobile storage battery.—*Illustration Courtesy United Elec. Prod. Mfg. Co.*

NO matter how carefully one may drive an automobile, trouble is bound to come up. The trouble light described here is a friend in need. It is a powerful light on an electro-magnetic base, attached to a ten foot cable cord equipped with spring clips. This wire may be clamped to the terminals of the storage battery or hooked on any circuit in the car's electrical system. The light can then be placed on any iron surface, and its magnetic power will keep it there, leaving both hands free to do whatever work is necessary. As an emergency tail light it will stick on the spare rim and stay there no matter how rough the road. The coil and the 21 candle power lamp draw 3.2 amperes at 6 volts. The lamp is protected from breakage by a metal guard. The magnet pole faces are ground off flush with the base, and thus the light readily adheres to any metallic surface on the car. This novel light should prove especially useful when making repairs on the car at night. A sketch of the device, showing its construction, appears here and should make the details clear to the reader.

Students Study Electrical Refrigeration



At the left we have a view of the refrigerating equipment which is being assembled by the students. Note that all necesary apparatus is furnished and the refrigerating unit itself is of the standard household size.—*Photo Courtesy School of Engineering, Milwaukee.*

A COURSE in electrical refrigeration is now being offered by one of the larger engineering schools. This course extends over a period of three months and intensive training is given to all students. The photograph shows a group of students engaged in testing an electrical refrigerator of the household type. The refrigeration laboratory is fully equipped with all well known makes of household units. Much specially designed apparatus is available both for conducting tests and experiments on the actual refrigerating equipment; such as heat and insulation tests, determination of efficiency, the properties of refrigerants and the like. The course in refrigeration is amply supplemented by laboratory work, in addition to the classroom lectures in which the essential theory underlying the science is presented. Any student completing a vocational course may register for the electrical refrigeration course. The training given in this three months course covers every branch of refrigeration and should enable the graduate to service, repair and install household units of any well known type. As the principles of refrigeration used in the different machines are all the same, the student should in fact be able to repair the commercial units as well as the smaller ones used in the home, with little or no difficulty.

Living Plants in Sealed Containers

No Attention Need Be Given Ordinary Garden Plants When Grown in Sealed Containers

By JOSEPH H. KRAUS

ONE of the most unique systems for the cultivation of indoor plants is the method patented by Raymond H. Wallace of Livermore, Iowa, under his patent No. 1,621,818, issued to him on March 22,

Above is a photograph of the garden variety of Tobacco plant. In the sealed container it requires no attention for two years.

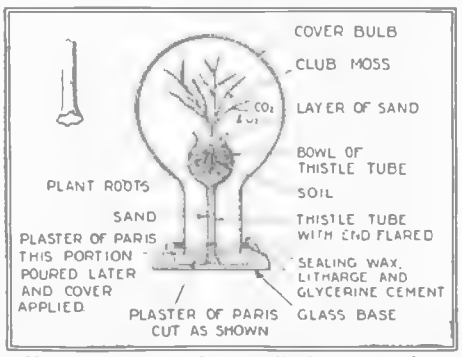
1927. In this system he has taken advantage of the more or less "balanced" plant life process of photosynthesis and respiration in such a manner as to maintain certain plant life essentials in proximity to the plant to be absorbed there. In the process of photosynthesis, carbon dioxide absorbed by the plant combines with water, in the presence of light, to form carbohydrates and set free oxygen.

In the process of respiration, the carbohydrates formed in the manner just described and the oxygen break down to form carbon dioxide and water. This latter action takes place in either light or darkness. The oxygen set free during photosynthesis is taken up during respiration and conversely the carbon dioxide set free during respiration is taken up during photosynthesis. In the present system, both the carbon dioxide and the oxygen set free by the plant are maintained in close proximity to the plant by the sealed container which completely surrounds it. The plant need never to be watered. The water given off during metabolism and transpiration collects on the glass container, permeates through the plaster of Paris subbase and is again reabsorbed by the plant. Not only is the object artistic, but it is extremely novel and is unique.

Mr. Wallace found that his method was applicable to all plants of the vascular type. It is a well known fact that bacteria are necessary in the soil in which a plant is rooted, in order to properly support plant life. Accordingly the soil in the thistle tube is selected so that it shall be rich in bacteria. Of course, it must be of the necessary character and of a quantity according to the size of the plant. The soil essentials are supplied to the plant through the roots in the usual manner and it has been found that for a relatively small plant, a very small quantity of soil may be employed which will not become too impoverished to maintain life, for a number of years. Before the plant is sealed in its container, a sufficient quantity of water is supplied to the soil. After that the plant requires no further attention.

The photographs on this page show two plants sealed in glass containers, which, for experimental purposes may be made from large incandescent bulbs. The requisites are few; thus by inspecting the diagram we find that there is a glass base which may be colored for its decorative effect. This glass base is set on the table awaiting the next step in the process of preparation. This consists of taking an ordinary thistle tube, such as the average chemist uses, and by heating the lower end, after having cut it to the desired size, the end is flared out with charcoal or by any other suitable manner so that it becomes quite irregular and more or less enlarged. It is desirable that the base of the thistle tube does not touch the glass at all points; otherwise the water given off could not feed back into the thistle tube. One will observe in the drawing that the very bottom of the thistle tube, therefore, appears more or less convoluted. Having constructed the thistle tube, the next step is to mix some plaster of Paris, pour it into the base with the thistle tube upright and as near the center of the base as can be judged. The article is held there until the plaster of Paris is nearly dry, after which the plaster is cut with a sharp knife or other suitable tool so as to form a cone-like center support. The thistle tube is now filled as far as indicated with some fine white seashore sand which serves to convey the water back to the roots of the plant by capillarity and white sand is used primarily for decorative purposes, any other kind sufficing. The middle portion of the bowl of the thistle tube is then filled with the desired soil well enriched. One must remember that this plant is to receive no attention for two years or more and it follows that the soil should be of a suitable nature to support life. If the plant thrives best in a sandy soil, the bowl should contain such material and if loam is the desirable cultural medium, this should be here introduced. A very small plant, preferably of dwarf habits, is then placed within the thistle tube and a final thin layer of sand is used to surface the thistle tube. Now, the plant is watered, an additional quantity of plaster of Paris is poured into the base and the cover bulb (an incandescant light bulb or other thin decorative glass) is immediately put in place and allowed to harden in the plaster of Paris.

Plaster of Paris will permit water to permeate through it. Consequently, in order to prevent any of the water in the container from finally escaping into the air and thus making the soil within unusually dry, a thin layer of a cement made of litharge and glycerine is put around the base as indicated in the diagram. This cement will adhere very well to the plaster of Paris in the base. On top of this to finish the job and to further prevent any evaporation, a layer of sealing wax is evenly poured. The sealing wax can be of a color to contrast with the glass base, thus enriching the novelty.

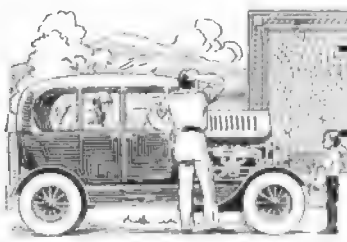


Here are the complete details for duplicating the remarkable self-contained plant novelty.

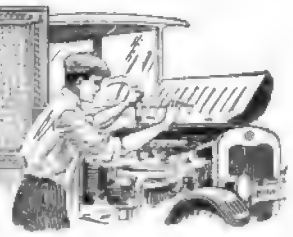
The mimosa or sensitive plant can be grown under the glass covering. The resulting article is artistic as well as unique.

The operation of the system is as follows. The process of photosynthesis and respiration is carried out within the bulbous cover in the usual manner, free oxygen being given off from the plant during photosynthesis, while carbon dioxide is given off during respiration. It will be apparent that with the hermetically sealed container, the oxygen and carbon dioxide will be maintained in substantial proximity to the plant to be reabsorbed by the plant during its natural functions. Metabolic and transpiration water will also be retained in the system and will be continuously absorbed by the plaster of Paris. The moisture finds its way down the sides of the cover bulb through the plaster of Paris and up the thistle tube because the bottom ends being flared out, permit the moisture to enter the same. Here, due to the capillary action, the moisture rises upwardly to be finally returned to the earth and thence to the roots of the plants. Aside from the carbon dioxide, oxygen and water, the only additional material needed by the plant is supplied by the soil.

Those of us who like to experiment with plants during winter months will find this an admirable method. It is of course not absolutely necessary that thistle tubes be used to hold the plant, but broken test tubes with bell tops or for that matter, large test tubes without any flare at the top, could be employed in much the same manner. These test tubes will probably enter smaller electric light bulbs without difficulty. While some plants may not live for as long periods as others by this method, the value of the system from both experimental and practical standpoint can readily be realized.

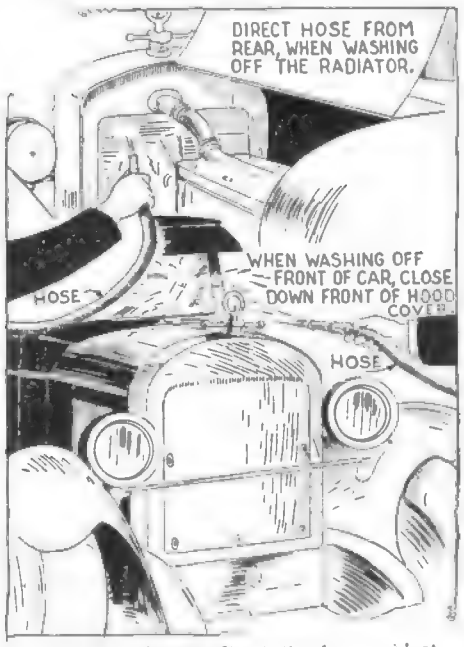


Motor Hints



Conducted by GEORGE A. LUERS

CLEANING THE RADIATOR


DIRECT HOSE FROM REAR, WHEN WASHING OFF THE RADIATOR.
WHEN WASHING OFF FRONT OF CAR, CLOSE DOWN FRONT OF HOOD COVER
HOSE
HOSE

In washing the car direct the hose against the rear of the radiator, to prevent wetting the ignition apparatus.

A great deal of mud is thrown up from winter roads, resulting in clogging the radiator fins. The inclination when washing is to direct the hose on the front of the radiator. A safer method is to raise the hood and direct the stream from the hose to the back of the radiator.

The difficulties of starting a motor in cold weather having a wet ignition system will thus be avoided.

If an engine hood cover is used, it is advisable to close the front flap while washing off the car. By doing this it is possible to wash freely around all the front area of the car, the hose stream being prevented from entering the engine.

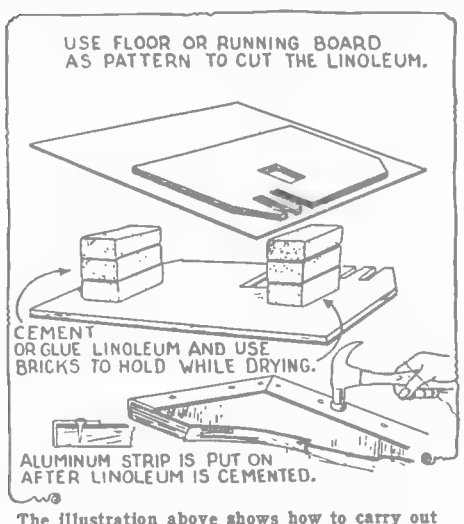
RECOVERING FLOOR AND RUNNING BOARDS

Linoleum on the running boards and the front floor boards of the car, showing holes from wear, is a detail which the owner can attend to and considerably improve the appearance of the car. Second hand cars, frequently are in this condition, and regardless of new fresh paint, they have a shabby appearance.

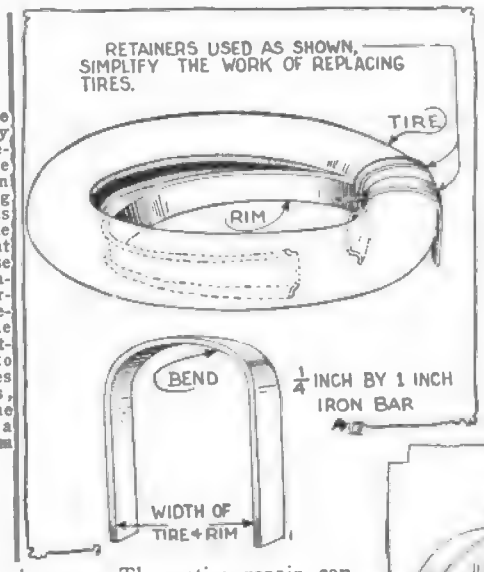
To renew the linoleum is only a matter of purchasing about two square yards of brown or grey inlaid linoleum, costing about four dollars, though short lengths can frequently be bought for one or two dollars.

To renew, remove the front floor boards. Take off the aluminum binding. Use pliers to draw out the nails, and avoid bending the aluminum strips. Use the boards as patterns to cut the covering with. After cutting, it is advisable to cement the linoleum to the wood with linoleum cement or in the absence of this, use cabinet maker's glue. Leave the boards on the linoleum over night, weighting them down with bricks or other weights.

After this the aluminum bindings can be replaced and the boards are ready to go back into the car. The entire repair can be done in two hours' actual work and the cost should not exceed two dollars.


USE FLOOR OR RUNNING BOARD AS PATTERN TO CUT THE LINOLEUM.
CEMENT OR GLUE LINOLEUM AND USE BRICKS TO HOLD WHILE DRYING.
ALUMINUM STRIP IS PUT ON AFTER LINOLEUM IS CEMENTED.

The illustration above shows how to carry out the replacement of linoleum on your running board or floor.



This simple but very handy device to be used in changing tires on rims can be made up at slight cost. These iron retainers are particularly useful when one person attempts to change tires on rims, without the use of a regular rim tool.

REPLACING TIRES ON RIMS

When replacing tires on rims, it is sometimes difficult to keep the tire beads down inside the rim, while forcing the opposite side into place with the tire tool. If the tube and tire slips around, so the valve stem does not project squarely inside the rim, the tube may be strained at the valve; in addition to making it hard to mount the tire on the wheel with the valve cocked to one side. This trouble must imperatively be rectified.

To avoid difficulties in tire and rim assembly, two small "U" clips as shown in the above sketch, will prove a most useful aid.

These clips can be bent up from one inch by one-quarter inch strap iron in a few minutes.

These are placed at the sides of the valve, after starting the rim in the tire; they hold firmly and allow of the fullest freedom to complete the assembly. These are even more useful than having an assistant.

CARE OF AUTOMOBILE HORN

If the horn of the car you are driving requires you to stop and strike the horn or motor-end, or vibrate it with your hand, whenever you want to start it to blowing, you have need of immediate horn repairs. So much dependence is put into the horn, that it is essential for it to blow.

In the motor actuated horn, three difficulties are frequently encountered.

(a) Dirty commutator and brushes.

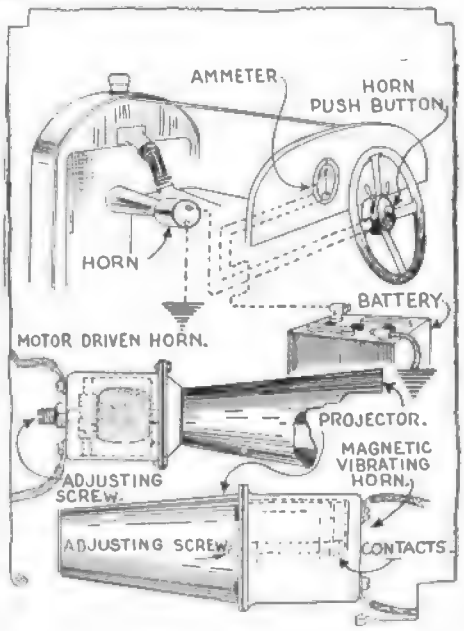
(b) Adjustment needed because of wear at diaphragm teeth.

(c) Broken or shorted wires in the circuit.

The commutator of the horn is similar to that of the generator and this should be cleaned with a piece of fine sandpaper, never emery cloth or paper, each six months; it should be then wiped clean with a cloth. Brushes should be long enough to bear firmly on commutator. By means of the adjusting screw, the armature is moved forward to compensate for wear at the diaphragm. A break in the horn wire causes failure. A grounding of the horn wire shows on the ammeter when the button is pressed. A ground or short in the two wires may cause the horn to blow continuously.

DO YOU KNOW—a simple method to test gasoline is to burn a teaspoonful in a cup or china dish? The resultant tarry deposit or soot indicates the quality. The cleaner the receptacle, the better the gasoline.

The illustrations below show several useful hints to the motorist endeavoring to adjust the horn.



A horn that goes out of commission on the road, can frequently be brought back, by simply wiping off the commutator with a rag. The ammeter should read between 6 and 8 when the horn is used. If more

(Continued on page 928)

Can You Answer These Scientific Questions?

SCIENCE and INVENTION Magazine readers, especially our thousands of friends in schools and colleges everywhere, have frequently testified in their letters to the editors that they obtain invaluable help from the columns of this magazine, in clearing up technical questions which arise daily. It is a recognized fact that everyone today, including those of both sexes, are expected to have a fairly good general knowledge of the latest scientific developments and discoveries. It is quite impossible to obtain this knowledge of the latest conquests in science from text-books, as they are usually revised but once a year, and in many cases not as often as that. You will find the questions below a good challenge to your knowledge of modern science, and we advise you to form your own answer, before you turn to the page referred to in each case.

1. What simple principle of applied optics is involved in producing natural cloud effects on the modern theatre stage? (See page 884.)
2. From your knowledge of electrical and mechanical matters, what horse-power motor would be required to rotate a six-foot wagon wheel, to which several skaters clung in order to be whipped off? (See page 886.)
3. How has science recently made absolutely safe the testing of high speed machinery, the rotating members of which sometimes burst during test? (See page 888.)
4. Through your familiarity with the huge modern locomotive and its approximate weight, how many of the early locomotives would be equivalent in weight to one of these modern giants of the rails? (See page 889.)
5. How do the chief operators of the vehicular tunnel under the Hudson River know at all times the condition of the tunnel atmosphere and the percentage of poisonous gas it contains? (See page 890.)
6. Do you think it is possible to positively locate oil, or other underground deposits, by simply swinging a pendulum over the spot? (See page 891.)
7. In what way do you consider it possible for television to become a worthy aid to the astronomer in fathoming the secrets of the stars? (See page 892.)
8. Did you know that glass bottles are now made at high speed, entirely by machinery? (See page 896.)
9. Several million American motor cars have been built with poppet valve engines in them. Do you think a rotary valve instead of a poppet valve can be successfully applied to a gasoline engine? (See page 898.)
10. Where does the pituitary gland lie in the human body? What is the usual effect of over-activity of this gland? (See page 899.)
11. What is a flash boiler? What is the highest speed which a model ship, thirty-six inches long, can attain? (See page 907.)
12. What are Prince Rupert's drops? Do you know how to make them? (See page 913.)

Trained Salmon—A Fish Story

By H. L. DILLAWAY

Here is a photograph of Mr. Lang holding a hoop and making a trout leap through it.

In a large concrete basin, Mr. Charles Lang, of Port Townsend, Wash., gives us a new and original version of a fish story. He has trained salmon trout to answer his beck and call.

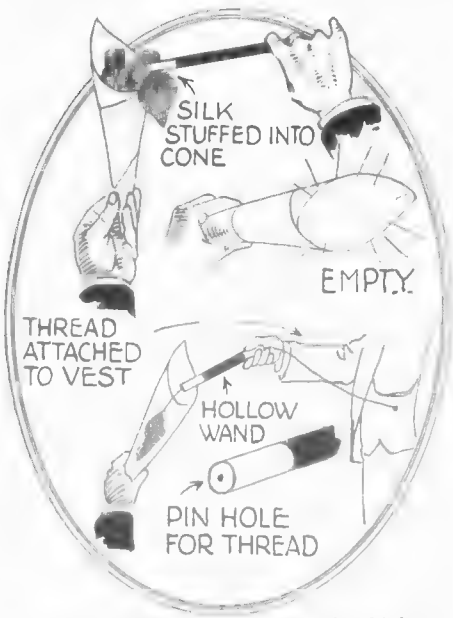
Note the curve assumed by the body of the fish after it passed through the wooden hoop.

The photo at the left shows a trout coming up to pick a scrap of meat held for it. Photo above shows spectators watching the performance, and the one at the right shows a salmon trout nearly out of the concrete basin.

MAGIC By "DUNNINGER"

NO. 59 OF A SERIES

VANISHING HANDKERCHIEF



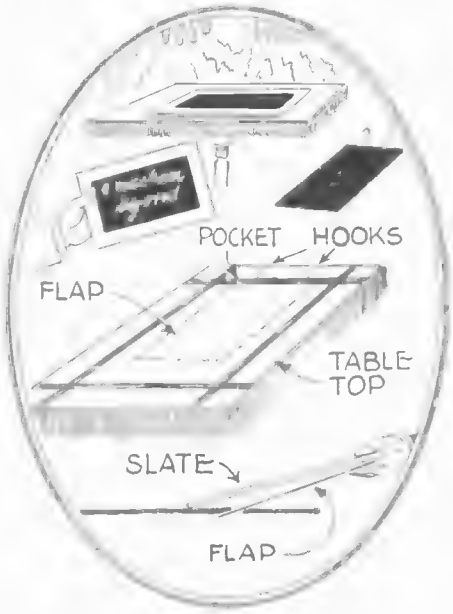
By the aid of the wand shown, a kerchief can be pushed into a paper cornucopia and caused to disappear. The thread arrangement limits fussing.

HERE is a new and effective method of performing the ever-popular vanishing of a handkerchief from a cornucopia trick. It is well known that in the former method of procedure, a double wand had to be employed and it frequently required considerable fussing with the end of the wand to produce the effect. In this method, a fine silk thread is tied to the magician's waistcoat button which leads through the tube, and is then attached to the handkerchief. In the act of tucking the silk into the paper, the movement of the hand forward draws the silk into the interior of the wand. The thread is broken before the wand is laid down on the table or side stand.

NEW SLATE EFFECT

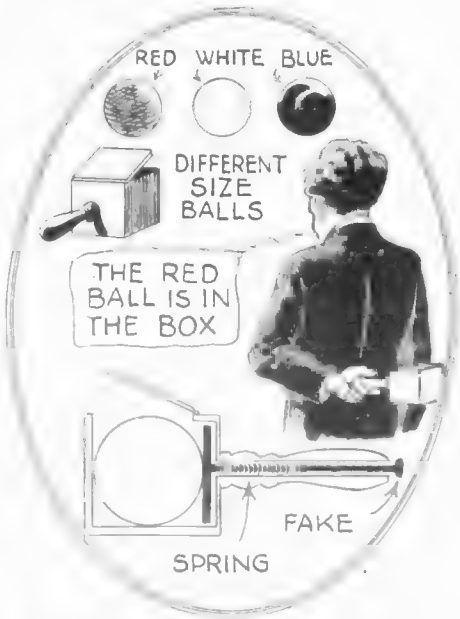
A SCHOOL slate is first passed for examination and may even be marked for identification, if desired. It is placed flat upon an apparently unprepared table and then fantastic passes are made over it. On being lifted, a complete message is found.

A slate flap is employed, but the method of its use is quite unlike anything heretofore published. The spirit message is previously written upon the surface of this flap and then concealed in the pocket of a table top. This pocket is covered with strips of gold braid in a design similar to the one indicated. Two small hooks are attached to the edge of the flap to engage the slate as it is being lifted in the act of picking it off the table.



A slate is passed for examination, placed on the table and when it is again lifted it will be found to contain a message of greater or lesser importance.

ENCHANTED BALLOT BOX

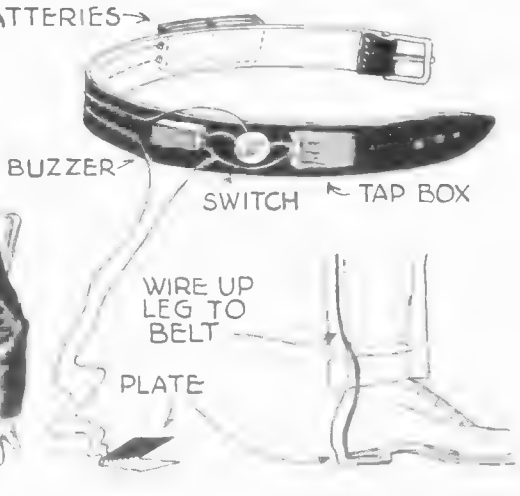


While the magician leaves the room, one of three colored balls is put into the ballot box which is closed. The other balls are concealed.

FOR those who admire psychical effects this is bound to create quite a sensation.

A wooden box, provided with a handle, is made just large enough to receive one of three differently colored balls. The cover of the box can be closed tightly and locked in place. It is handed to the magician as he enters the room, and he is able to tell instantly the nature of the ball contained within the box, even when the box is held in back of him. Shaking produces the same sound in each event. The effect is obtained by having the balls of three different sizes, varying but slightly. A nail secretly pushes the wall of the box against the ball and the depth of push determines the color.

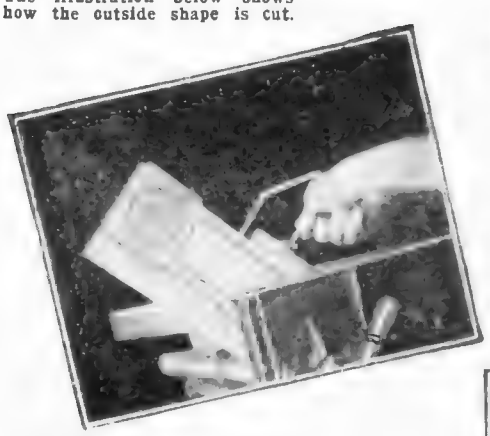
SPIRIT RAPS IN BROAD DAYLIGHT

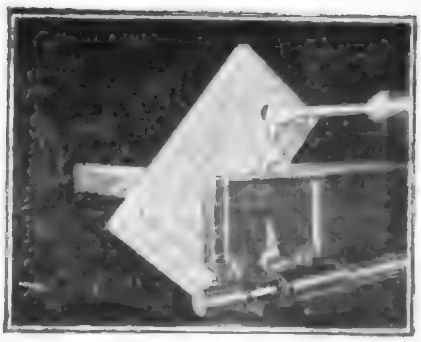


Mystic table rappings in broad daylight and messages in the wireless code are obtainable with the device indicated. Due to the position occupied by the magician or medium, it is quite impossible to tell from whence the sounds come. This is particularly true if the magician leans against the table and causes the tap box or the buzzer to actually touch any portion of the wood of the table. When this is done, the sound comes from a different point, dependent upon the position of the spectator and his ability to argue the point out convincingly.

IN order to produce the spirit raps here indicated, a belt is especially prepared with two small flashlight batteries; a single pole double-throw switch and a buzzer and tap box, or gong-less bell. The heel plate is made of two pieces of metal, separated by a thin piece of fiber and is placed under the heel and inside the shoe of the wearer. By depressing this plate, either the buzzer or the tap box will sound at the will of the operator. If he can manage to press either element against the table-top, the sound apparently comes from within the very fiber of the wood. This is ideal for spirit seances and the amateur will find many other ways of utilizing this idea.

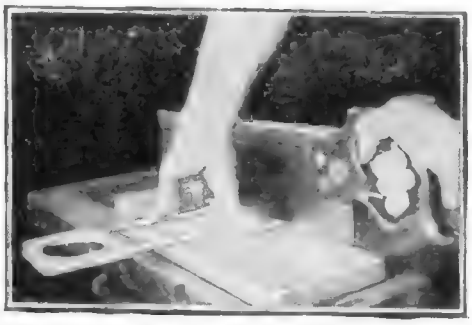
The illustration below shows how the outside shape is cut.





Boring a hole to fit the clock.

Below, cutting out the panel with a plane bit.



Much of the straight sawing can be done with a back saw.

Alarm Clock Case from Wall-Board

By H. L. WEATHERBY

Full working details on how to build this useful ornament

THE making of an alarm clock case from any of the standard brands of wall-board is an extremely simple task and the result as the illustrations show, is very much worth the effort.

Wall-board, known by various trade names, is such a universally used product now-a-days that almost everyone has scraps of it around the house, and that is nearly all that is necessary for the construction of the case shown; that and a little gay colored, or ivory lacquer, and a transfer design which can be purchased from almost any paint store.

Before starting the case, by all means secure the clock. A small size will answer better than a large one, and the drawings shown call for a "Baby Ben." However, by slight changes in the dimensions the case may be made to fit any ordinary alarm clock.

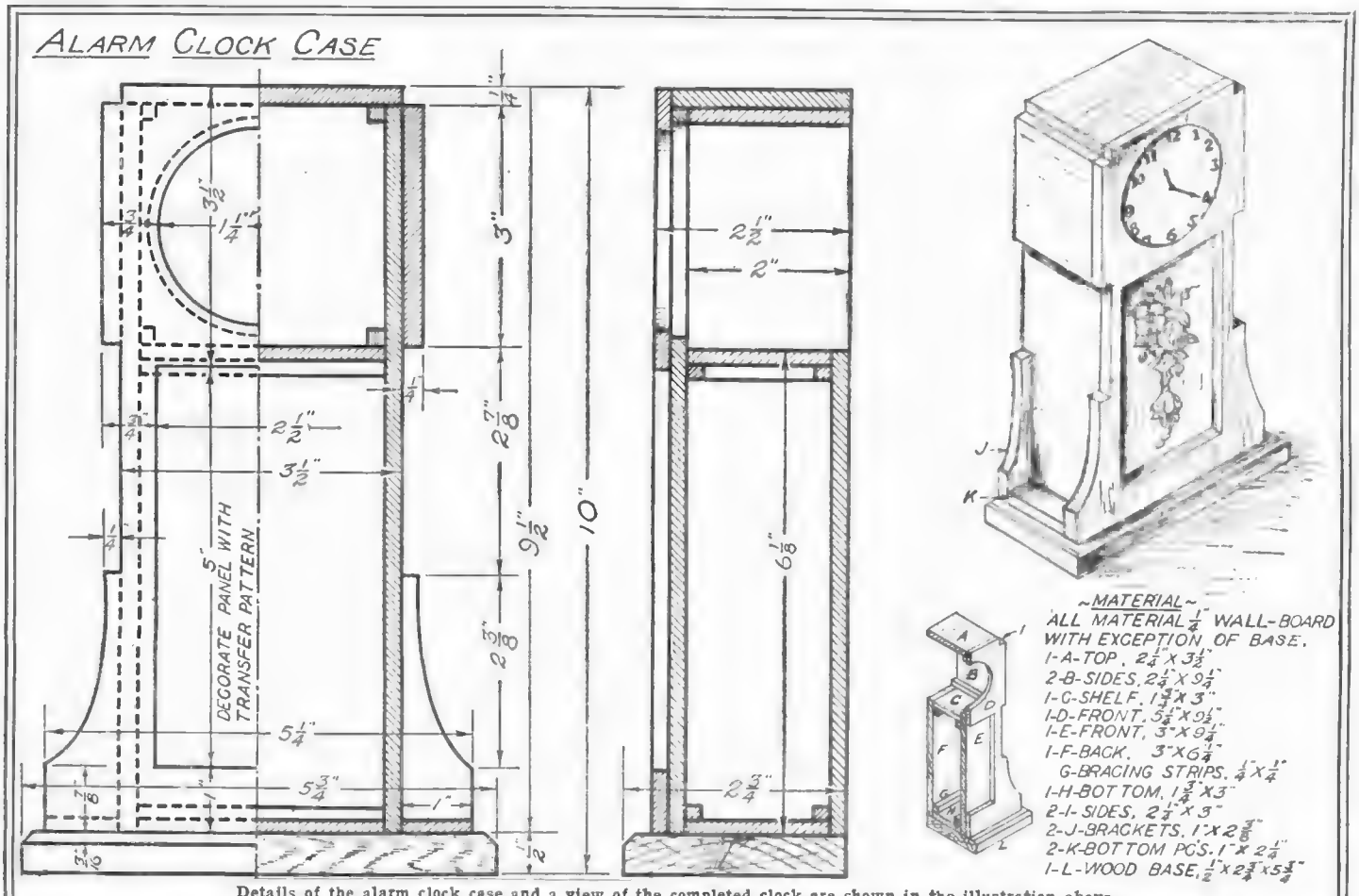
To begin, cut to sizes given in the material list, the pieces of wall-board, using a fine tooth saw or knife. No nails are used in assembling the parts, tacks as well as glue being used in attaching the bottom to the case, otherwise all parts are simply glued together. The bottom or base is made of wood and can be loaded if desired, by boring holes and filling them with molten lead. In the piece for the front of the case, listed as "D" in the material list, bore a hole at the desired location and to fit the clock, using an expansion bit, being sure to place a piece of wood back of the wall-board when boring. Lacking an expansion bit, this hole may be cut with the small sharp blade of a pocket knife, or with a coping saw, following a circle made with a pair of dividers.

The bottom part of this piece, which is cut out to form a panel, may be cut best with a plane iron, using it as a chisel and having a block of hard wood under it to receive the cutting edge, thereby preventing the wall-board breaking off.

The remaining parts, with the exception of the curved pieces marked "J," are all cut square and to sizes given. These curves and the ones on part "D" are cut with a coping saw or with a sharp knife.

Now we are ready to start assembling the

(*Continued on page* 947)



Details of the alarm clock case and a view of the completed clock are shown in the illustration above.

Model Department

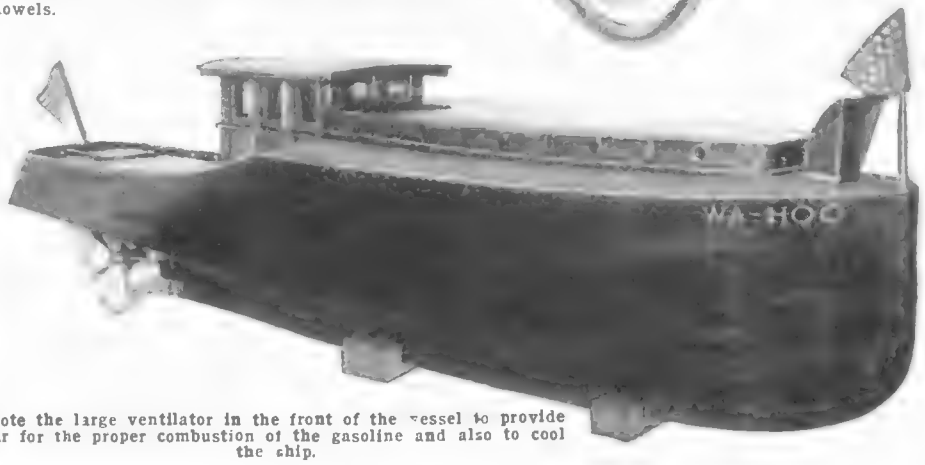
MODEL SPEED BOAT WINS CUP

Prize Awarded to Edwin Benzenberg

Above we have a view of the model speed boat which was awarded the SCIENCE AND INVENTION trophy for the month of February. The hull is diagonally planked, then covered with silk and white lead, and then the longitudinal planks are added. The entire construction is held together by "toothpick" dowels.

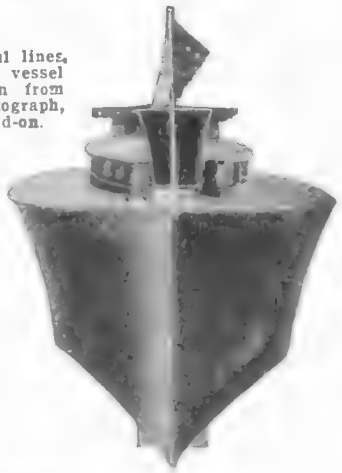
Rules for Model Contest

1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based on: A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.
2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.
3. Models may be made of any available material, preferably something that is cheap and easily obtainable.
4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.
5. Models should be securely crated and protected against drainage in shipment and sent to us by parcel post, express or freight prepaid. Models will be returned when requested.
6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the April contest must reach us on or before the 25th of January.
7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.



Note the large ventilator in the front of the vessel to provide air for the proper combustion of the gasoline and also to cool the ship.

ON this page we show a series of photographs of the beautiful prize-winning model speed-boat, built by Edwin Benzenberg, at Stuyvesant High School, in New York City. The Wa-Hoo is 48 inches long and has a beam of 8.6 inches and a draft of 4.07 inches. It is capable of a speed of more than 25 miles an hour. The position of the flash steam boiler can be seen in the photograph below. One will observe that the compartment in which it is placed is lined with asbestos. The gasoline tank is well up forward. The pipe which projects over the side of the vessel is attached when the boat is running, and takes care of exhaust steam, preventing any damage to the mahogany hull and cabin.

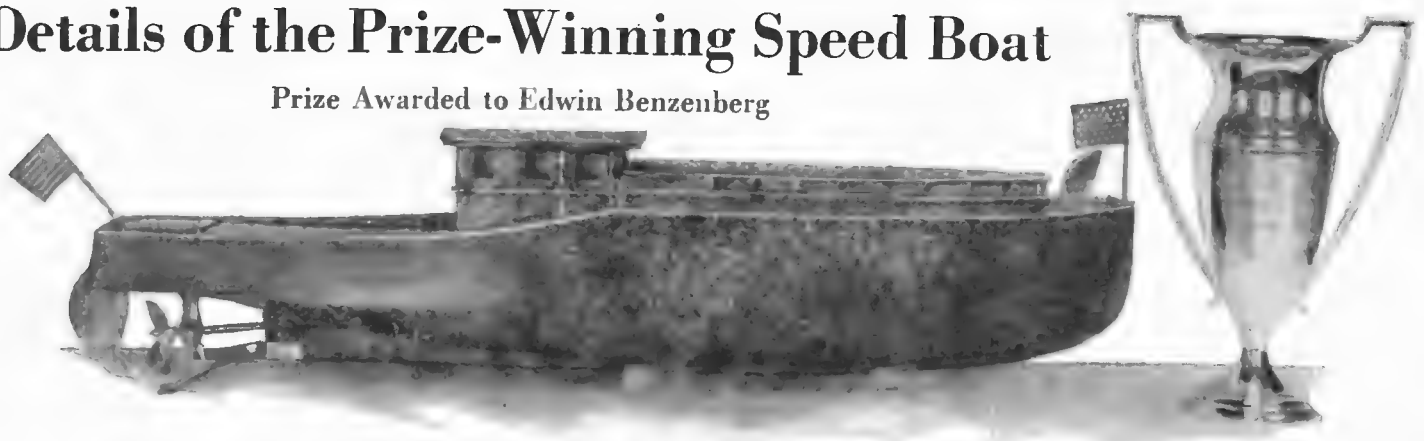


The beautiful lines of the model vessel can be seen from this photograph, taken head-on.

The photograph below is a top view of the boat with the superstructure removed to show the position of the steam plant. The steam engine has a forward and reverse gear; the cylinder has a ⅞-inch bore and a 1-inch stroke. It is double-acting single-cylinder type.

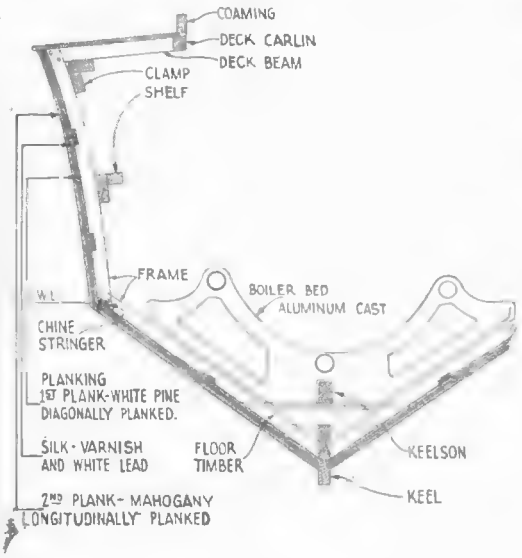
Details of the Prize-Winning Speed Boat

Prize Awarded to Edwin Benzenberg



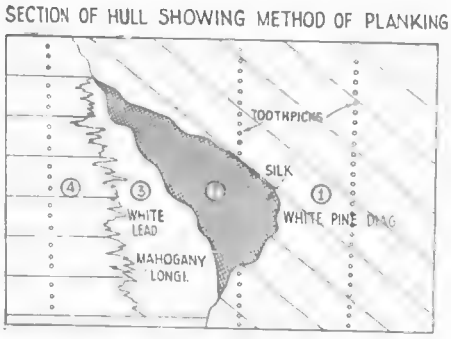
Above is a photograph of the "Wa-Hoo" and the cup which was awarded to it. One of these cups is awarded monthly by this publication for the best model submitted during the month.

The rules of the contest appear on the previous page, where a fuller description of the nature of the contest will also be found.

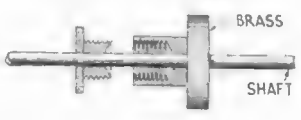


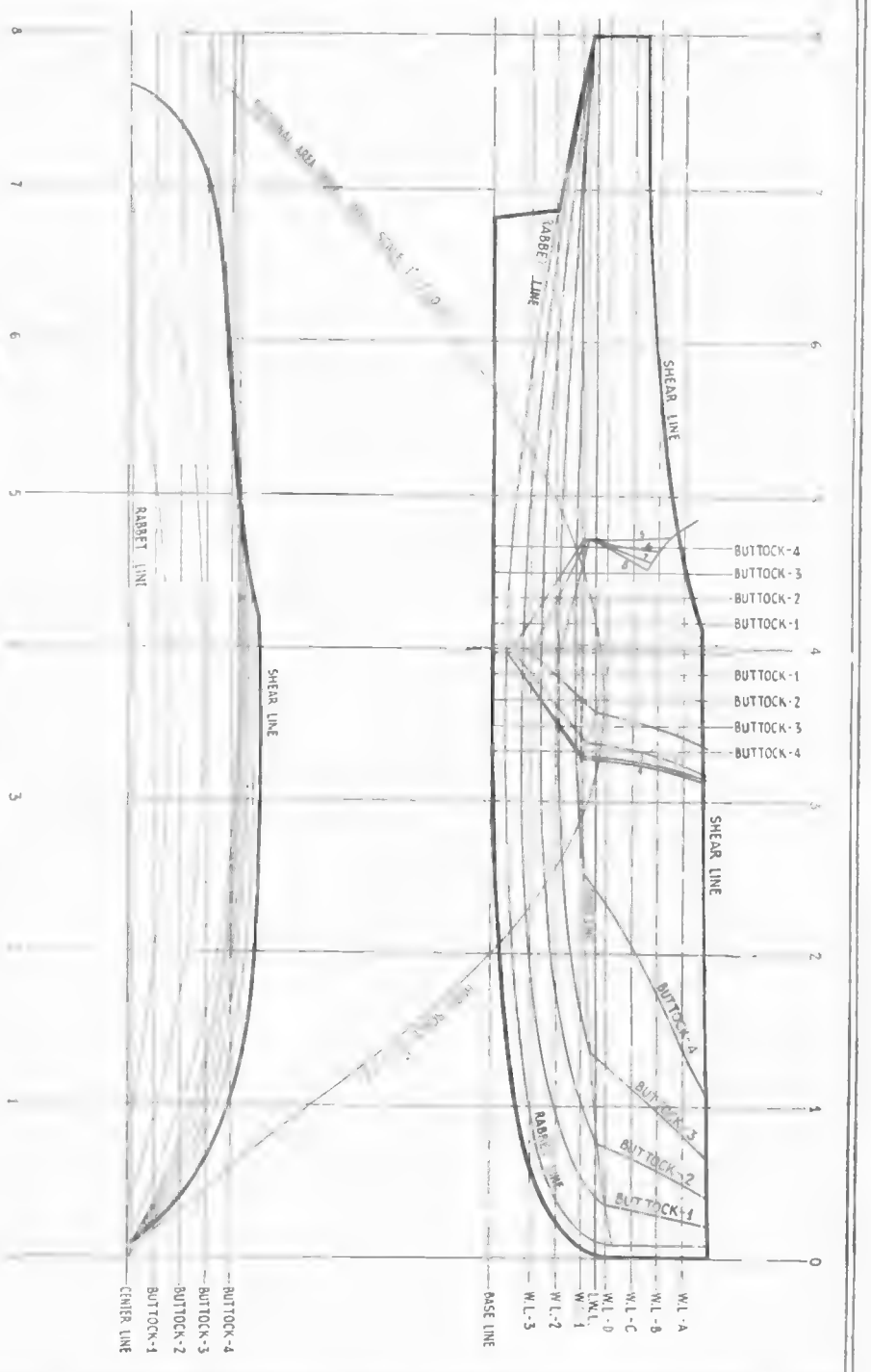
SECTION OF FRAME Nº 4
LOOKING AFT

SECTION OF HULL SHOWING METHOD OF PLANKING



SECTION OF STUFFING BOX



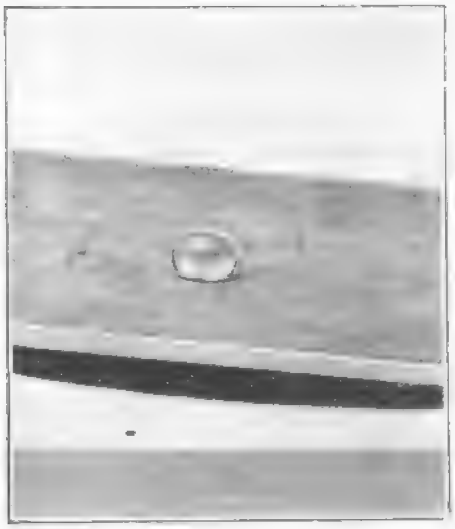


Here we have the complete details indicating the various hull lines of the "Wa-Hoo," with a further explanation showing how the hull was built up.

The boiler bed was cast from aluminum, after a wooden model of the same had been made. The stuffing box was turned out of brass rod.

Easy Experiments in Chemistry

By RAYMOND B. WAILES



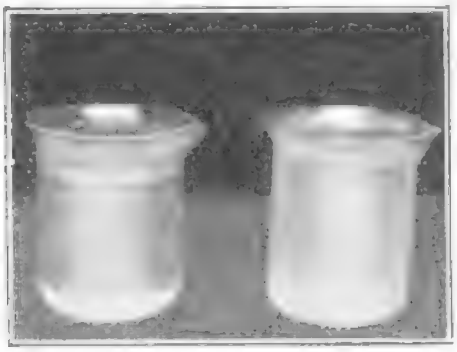
The spheroidal state of water is easily shown by dropping water on a hot metal plate. It forms a bright, restless spheroid.

SPHEROIDAL STATE

We have often spit upon a hot stove—who hasn't resisted this temptation? But how the little globule of water rolled up and danced merrily on the hot surface! And how long it remained there! This is caused by the formation of a film of steam around the bubble of water. The bubble floats or rests upon this ever forming layer of steam, being supported up by it much as a celluloid ball is supported by the jet of water of a fountain.

CLARIFYING WATER

Some of the most important applications of chemistry to everyday life are the simplest of chemical reactions. The purification of water by means of alum when the turbidity



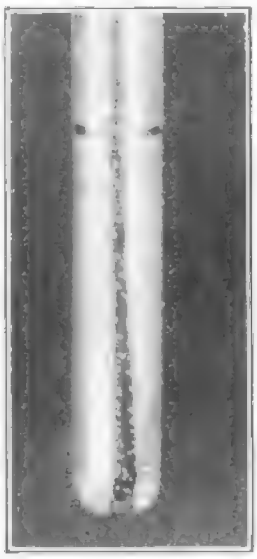
Alum has been added to the left-hand beaker of clay and water. Note the difference in rates of settling.

is high, due to clay or other insoluble substance in suspension, is one of the most widely known applications of chemistry. Yet to explain the theory of how this simple chemical does the work is often difficult. But to show with two glasses, or beakers, just how the process works is very simple.

For this entertaining experiment take some Fuller's earth, whiting, clay, mud or any solid which when mixed with water will stay suspended in the form of a cloud or mud for some length of time. Shake up the substance with water and divide it into two glasses or beakers before it settles. To one beaker add several drops of alum solution. For the course of some minutes watch the rate of settling of the two suspensions. The one to which the alum water has been added will be seen to clear up in a short length of time. The other will take longer. The principle upon which the experiment works is that the alum hydrolyzes forming an aluminum gel, or hydroxide, which in settling, carries or drags down the suspended particles.

METALLIC COUPLES

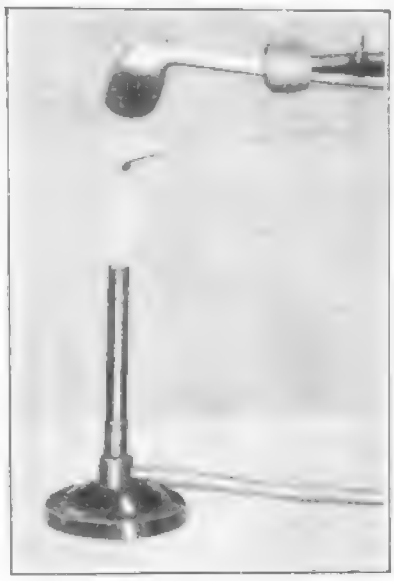
The rate of rusting of metals is usually greater if another metal is in contact with it, forming an electric couple. Metallic couples of this sort are widely known. If a strip of magnesium ribbon or wire is immersed in a 2% ammonium chloride (sal ammoniac) solution containing a bit (0.2%) of copper chloride, it will become coated with a closely adherent film of metallic copper. When this metallic couple is immersed in water, a steady stream of hydrogen will be given off, lasting for several hours, but longer, if 0.1% of ammonium chloride is present in the water.



A metallic couple is shown here decomposing water.

COPPER PLATING WITH A BUNSEN BURNER

The majority of chemical experimenters have enjoyed mixing batches of colored fires. For this purpose, copper salts are sometimes used to form a greenish-blue flame. If copper chloride is held in a Bunsen flame, the flame will be colored green. That this compound actually splits up, forming chlorine gas and metallic copper when it is volatilized in the flame can easily be shown. Hold the bowl of a bubble pipe (white clap pipe) or other cold porous surface in the flame colored green by cupric chloride. The bowl will become copper plated in a few seconds, and by buffing it, a good polish can be had. This is quite unique;



Copper plating with a Bunsen burner. The copper is carried up by the flame and plate itself upon the cold pipe bowl.

copper plating with a Bunsen burner! The green color of the flame is thought to be due to the *recombination* of the chlorine and the copper to form the copper chloride again.

FLAME FILTER

In bead tests for those metals giving colored flames when volatilized, cobalt glass is used to screen out interfering colors, especially yellow from sodium salts. Chrome alum solutions such as one containing about

Chrome alum solution in bottle serves as a good flame color filter in flame tests for metals.

35 grams of chrome alum per 100 cc of water and contained in square sided bottles will mask or cut out the flame colors of sodium, lithium, barium, strontium and cal-

(*Continued on page* 948)

ELECTRIC CANDLES

By A. BLUMFELD

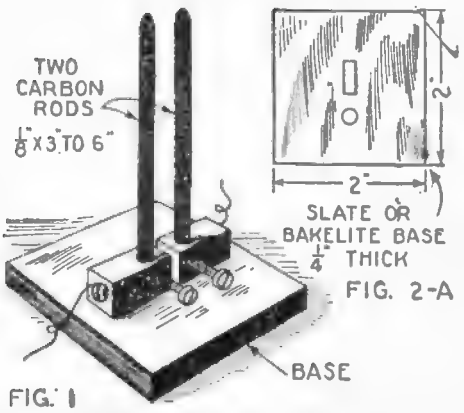


FIG. 1

FIG. 2-A

The electric candle which operates without any mechanism. Notice the slot in the base (in figure 2A) to permit the adjustment of the distance between the carbons.

WHEN the electric light was first introduced, the arc light was the form employed; the incandescent filament lamp had not yet been produced successfully. The great requirement was said to be the sub-division of the electric light. The desire was to produce it in small units and also to get rid of the mechanism for feeding the carbons in the electric arc lamps. In those days, which now seem so far off, these were constant topics of discussion.

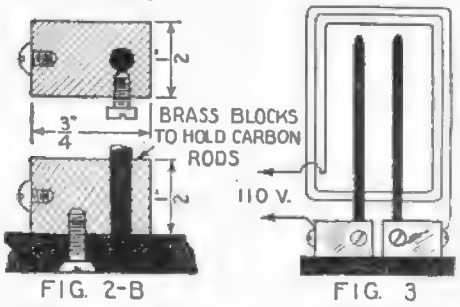


FIG. 2-B

FIG. 3

Sectional views of the base blocks, which hold the carbons; also (in Fig. 3) the establishment of an electro magnetic field around the carbons.

The Jablockoff candle, in a way, filled both these requirements. It consisted of two quite thin parallel rods of carbon, about 1/8" in diameter and not quite so far apart, and held in position by a diaphragm of plaster of Paris or some similar substance parallel one with the other.

We illustrate here a simple form of electric candle on the above lines, with which the experimenter in electricity can do some entertaining work. Fig. 1 gives a view in perspective. The two carbon rods of dimensions as quoted are carried by two metallic blocks. These blocks rest upon a 2-inch base shown in Fig. 2, A—one of them is held in fixed position by a screw passing through a round hole in the base; the other is held in position by a similar screw passing through a slot in the base, so that the distance apart of the blocks and consequently of the carbons, can be adjusted to suit. Fig. 2B gives sectional views—the lower figure is a vertical section of one of the blocks. The carbon is shown in black, reaching down through the brass block. To its left is seen the screw fixing the block on the base and on the left face of the block is seen a screw by which the wire carrying the current is to be connected. Immediately above a horizontal section is given of the same connection. In Fig. 3, the candle is shown all mounted with a wire coil surrounding the carbons to produce a field about the arc. Then in Fig. 4, it is shown connected in a 110-volt circuit, a resistance being in series with it, so as to cut down the current passing through the arc.

It will be observed that there is no diaphragm between the carbons. It was found in early days that this diaphragm was not absolutely required and it was dispensed with in many cases. Like its predecessor, this gives quite a small arc and to that extent the Jablockoff candle, operated to sub-divide the electric light into relatively small units.

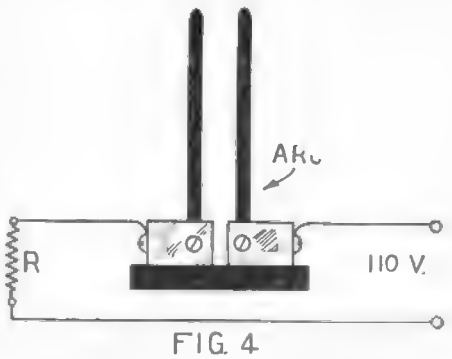


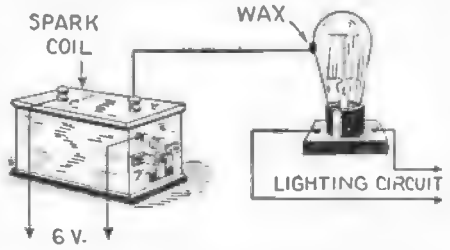
FIG. 4

Resistance in series with the carbons so as to reduce the current flowing through the arc.

FLICKERING SIGN

BY LESLIE F. CARPENTER

A sign that will attract attention anywhere can be made as shown in the diagram.



A very pretty experiment applicable to producing flashing electric signs.

A fine wire is run from a spark coil to each light and is fastened with sealing wax near the tip of the bulb. When the coil is running each light flickers and it presents a novel sight. Colored lights make it even more attractive.

Novel Electric Furnace

By S. R. MOORE, Reporter, No. 1993.

THE experimenter who desires to work with high temperatures and products made with their aid, such as calcium carbide, coke, etc., is greatly handicapped by the prohibitive prices asked for furnaces which will accomplish such work.

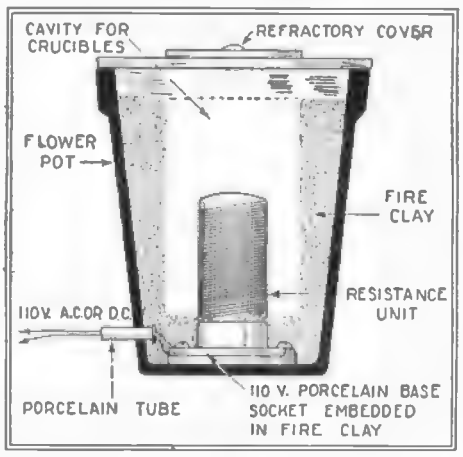
The writer is herewith offering an electric furnace of the crucible type, designed by himself, and which will, when properly and carefully constructed, give extreme service and satisfaction.

As shown in the sketch, the body of the furnace is in itself simple, being a flower pot of suitable dimensions, or a crucible of some refractory material, such as silica, limestone, magnesia, or alundum. A standard 110 volt porcelain base socket is mounted by means of two bolts upon the base or bottom of the crucible. The plug type resistance unit which may be obtained from most electrical supply houses for fifty or sixty cents is then screwed firmly into the socket.

Sufficient fire-clay or other refractory is then mixed up and placed in the bottom of the crucible so as to completely cover the porcelain socket. The sides of the crucible are also covered with an inch or two of the cement so as to leave a cavity in the center about 2½ or 3 inches in width. This is to hold smaller crucibles to be heated, etc.

Previous to the fire clay coating, wires are connected to the terminals of the socket and are led out through a porcelain tube passing through one side of the furnace, near the base. These are attached, when desired, directly to the 110 volt D.C. or A.C. circuit.

Upon completion, having exercised a little care and skill, this furnace will be found to possess features not unlike those contained in furnaces sold by large supply houses at a price many times as great as the original cost of a home-made product.



The illustration shows a very simple electric furnace made inside a flower pot, and depending for its heat upon an incandescent coil of resistance wire. This furnace is designed for the production of rather a low degree of heat, compared with that given by an arc furnace, and will be found a most useful adjunct in the laboratory.

While certain mechanical precision and standard products may be lacking in our domestic product, there is still much satisfaction for one who can really use and operate a self-made piece of essential apparatus for the laboratory, such as an electric furnace.

The applications for a furnace of this nature are almost innumerable. Aside from being used to fuse small quantities of various metals, heat treating, preparation of various chemicals compounds such as calcium carbide, etc., it will give good service as a heater for glassware, as distillation flasks, beakers, and retorts can be heated by it very satisfactorily.

TESTING SPARK PLUGS

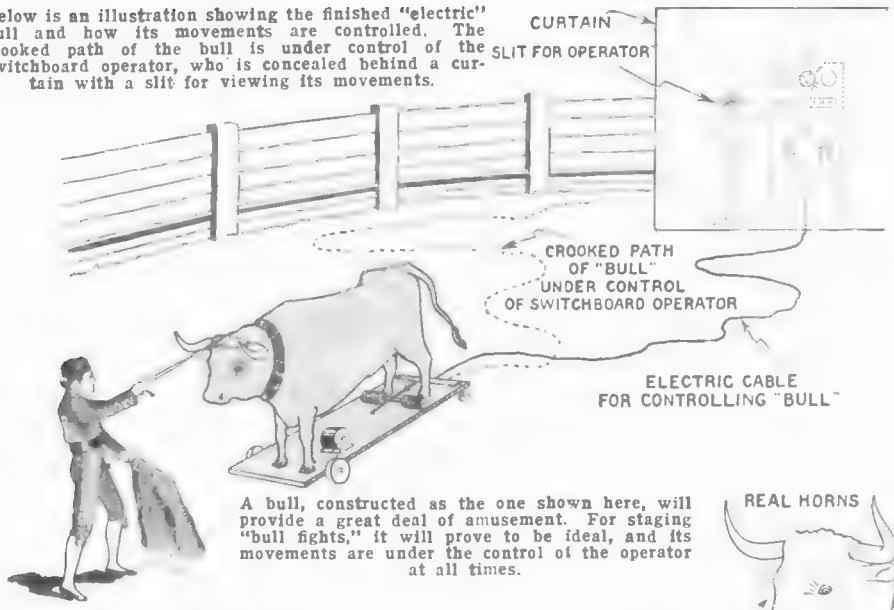
Connecting a Ford coil with its three terminals the plug is connected by special clips to save trouble and time and the secondary of the coil is connected so as to produce a spark when the switch is closed. The great point is to have all the connections very good. It is even advisable to solder the wire to the spark coil. After a little work on different plugs the eye will learn to discern a good plug from a bad one by observing the appearance of the spark and the work can be done very rapidly. Sometimes on cleaning a spark plug a good spark will be produced. If cleaning does not improve it, a new porcelain should be obtained or the plug may be thrown away.—*Harry E. Hudec.*

The Constructor

Making an "Electric" Bull

By HENRY TOWNSEND

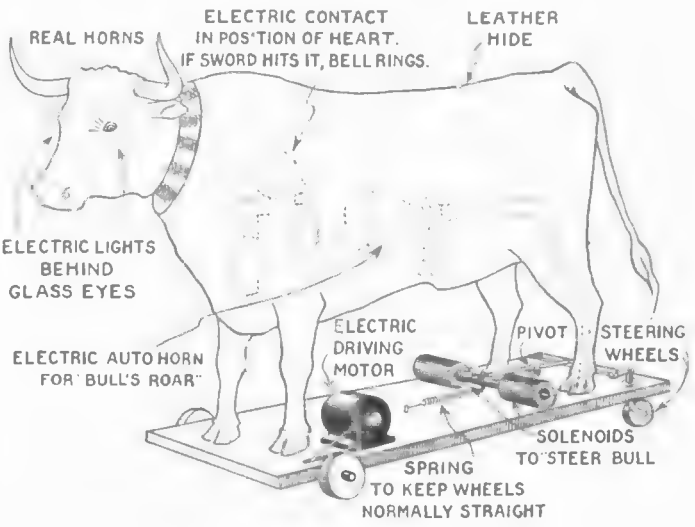
Below is an illustration showing the finished "electric" bull and how its movements are controlled. The crooked path of the bull is under control of the switchboard operator, who is concealed behind a curtain with a slit for viewing its movements.


CURTAIN
SLIT FOR OPERATOR
CROOKED PATH OF "BULL" UNDER CONTROL OF SWITCHBOARD OPERATOR
ELECTRIC CABLE FOR CONTROLLING "BULL"

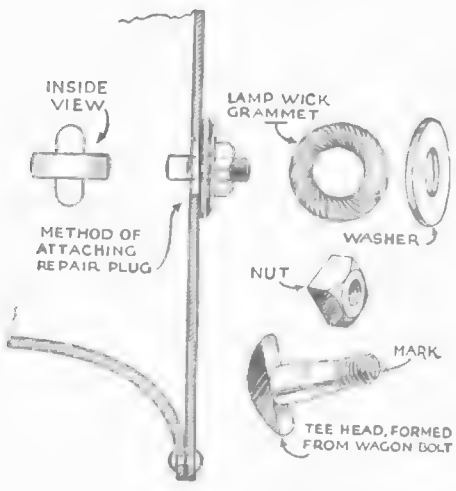
A bull, constructed as the one shown here, will provide a great deal of amusement. For staging "bull fights," it will prove to be ideal, and its movements are under the control of the operator at all times.

A electric bull should prove to be a novelty as well as provide a new means of lodge and club entertainment. With a beast of this sort, bull fights can be carried on without endangering the lives of the fighters. The bull is made with a strong frame which may be filled with sawdust and then covered with a leather hide. The bull is placed upon a wooden platform fitted with wheels, two of which are used for steering. A motor is mounted upon this platform and enables the bull to move forward or backward. Two solenoids are placed as shown and provide the steering apparatus for the bull. A spring is used to keep the wheels in a normally straight position. An electric auto horn may be placed inside of the bull to simulate the roar. Two glass eyes are used behind which electric lights are placed. An electric contact is arranged in the position of the bull's heart. When the matador's sword strikes this an electric bell rings and the bull is "killed." The wires leading to the motor and solenoids are connected to a switchboard. This switchboard should be concealed and a small opening allowed in the concealing partition or curtain, so that the operator may view the movements of the bull and the matador at all times. A bull of this sort will prove to be admirable for amateur stage presentations, and the only "blood" spilled will be the sawdust from the "wounded" bull. The head of the bull should be mounted upon springs which will give a more realistic effect to the bull fight.

At the right we have a drawing showing the constructional details of the electrical bull. An electric motor mounted upon the base provides for the propulsion of the bull, while two solenoids are used to steer it. A spring is used to keep the wheels normally straight. An electric contact is placed in the position of the heart and if the sword hits it a bell will ring. An auto horn is used to imitate the bull's roar. Real horns are fastened upon the head and two electric lights are used for the eyes.


REAL HORNS
ELECTRIC CONTACT IN POSITION OF HEART. IF SWORD HITS IT, BELL RINGS.
LEATHER HIDE
ELECTRIC LIGHTS BEHIND GLASS EYES
ELECTRIC AUTO HORN FOR BULL'S ROAR
ELECTRIC DRIVING MOTOR
PIVOT
STEERING WHEELS
SOLENOIDS TO STEER BULL
SPRING TO KEEP WHEELS NORMALLY STRAIGHT

Patching Water Tanks

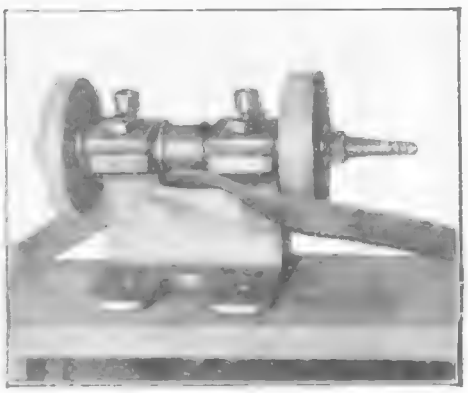


Above we have an illustration showing tank repair plug.

A patch bolt, which can be used for tanks containing liquids, is shown in the accompanying sketch. A wagon bolt with its head cut as shown is used. A grammet of lamp wick is made and a washer and nut is secured to fit the bolt. The bolt is tilted and inserted in the hole. A file mark on the end of the bolt shows the position of the head which should be across the slot. The illustration shows the correct position of the head. The method of attaching the repair plug is also shown.—*G. A. Luers.*

Emery Stand

The emery stand in the photograph was made from a 60-pound rail, four inches high, and hack-sawed to a width of 4½ inches. It has one-half inch bearings, a shaft, pulley, collars and thrusts. These are all turned from one solid piece of cold, rolled steel, thus simplifying the work of turning all these pieces separately. The bearings are of bronze. A washing machine motor, with a two inch pulley turning 1,700 revolutions per minute, operates the wheels.—*Vincent Negrette.*



The above photo shows an emery stand which was made from a 60-pound rail. A washing machine motor provides the motive power. The motor turns over at about 1,700 revolutions per minute, and operates the 4-inch wheels of this stand very nicely.

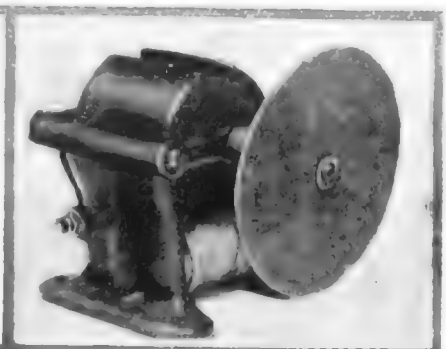
Some Experiments in Luminescence

Interesting Experiments Anyone Can Make with Easily Obtainable Materials, Such As Sugar

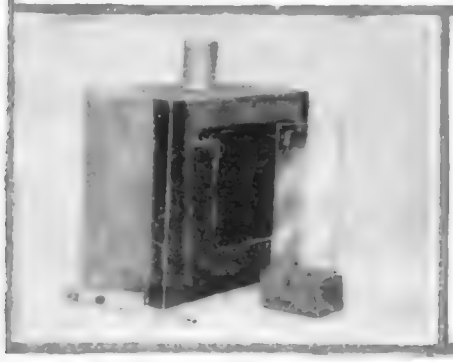
By RAYMOND B. WAILES

A small doll coated with a fluorescent substance will glow with rainbow-like hues when exposed to the action of ultra-violet rays. Some of the substances which can be used in this experiment are: quinine solution, vaseline dissolved in carbon tetrachloride and a solution of fluorescein.

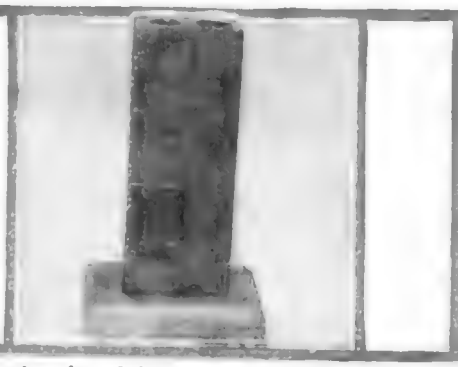
A card, coated with phosphorescent zinc sulphide, is partially shielded and exposed to red light. Upon examination it will be found that the exposed portion has become considerably dimmed. This may be taken as a rough proof that light of long wave length tends to extinguish phosphorescence.



A pretty experiment can be performed by coating a card with pulverized sphalerite and fixing this disk to the shaft of a toy motor. When the motor is operated, a shower of sparks will fly from the disk when it is touched, much like those which come from a grindstone.



In order to try out the luminescent properties of certain substances, a simple phosphorscope can be made. The completed device can be seen in the above photograph. It consists of a block of wood having two holes large enough to admit test tubes.



Another view of the phosphorscope appears in the above photograph. One of the test tubes can be insulated or exposed to the source of light by means of a movable brass strip. Sunlight or a carbon arc may be used.

Glass transmits some ultra-violet light. If, however, some sunburn lotion is smeared upon the glass and the glass interposed between the lamp and the object, it will no longer or only very slightly fluoresce, showing that the applied cream has shielding properties.

IF you will take a lump of sugar into a darkened room and when your eyes have become accustomed to the dark, break the lump in two, you will see faint flashes of light shoot out from the fracture. This is the simplest experiment which you can perform in that mysterious and fascinating realm of light vibration. It is due to a form of luminescence and is called tribo-luminescence, and is caused by the parting of the sugar crystals. Crystals of salicylic acid also produce this effect when fractured, as do those of potassium sulphate, and arsenious acid.

Sphalerite is a mineral, zinc sulphide in composition. The triboluminescent variety of this mineral will give off a shower of sparks when a hard object is passed across its surface. The stroke of a finger nail will cause a red trail of scintillations to appear. A pretty experiment using this mineral can be performed by coating a card with the pulverized mineral and affixing the disc to the shaft of a toy motor. When the motor is operated, a shower of sparks will fly from the disc when touched, much like those from an emery wheel or dry grindstone, acting on steel.

Varnish or glue can be used to coat the disc. Spread the adhesive upon the surface and when tacky sift or sprinkle the powdered triboluminescent sphalerite upon it and dry.

One of the most phosphorescent substances known is luminescent zinc sulphide. This emits a greenish luminescence after being exposed to sunlight, or to ultra-violet rays. It is used, mixed with a radio-active compound upon watches and clocks, making them luminescent. The experimenter can spend many an interesting hour experimenting with this substance.

If a card be coated with phosphorescent zinc sulphide and exposed to sunlight, it will glow vividly in the dark, the intensity of the glow decreasing with the lapse of time. If half of the card is covered or shielded with an uncoated card and exposed to red light, and then examined, it will be found that that half of the card which has been insolated or exposed to the "red" rays will have become considerably dimmed. This is a rough proof that light of long wave length tends to extinguish phosphorescence. It is likewise true that waves of short wavelength have the power of causing phosphorescence.

There are many substances which have luminescent properties. Some of the common ones are: acid solution of a quinine salt which can be taken from a quinine capsule, lubricating oils, vaseline, anthracene, calcium sulphide and other earth sulphides, solutions of aesculin, which is derived from the sticky buds of the horse chestnut tree, erythrosine, fluorescein in alkaline solution, anthracene in carbon tetrachloride solution, eosin, etc.

In order to try out the above substances to determine their luminescent properties a simple phosphorscope can be made. The photograph shows the completed device. It consists of an upright block of wood having two holes large enough to admit test tubes carrying the solutions under examination. One of the tubes can be insolated or exposed to the source of light which can be the sun, a carbon arc light, etc., by means of a movable brass strip which can be separated from a fixed brass strip by means of two screws. By having a straight edge the movable strip can be brought even with the fixed one, thus shutting out the light to the tube inside. Of course a hole must be made in the wooden upright where the slit is. The tube which is not exposed is used as the control tube, a standard or the same substance as is being used in the experiment being placed in this one. The ray of light coming through the narrow slit will cause a beam of luminescence to be set up in certain solutions.

Sometime ago the writer described in this journal for October, 1926, an ultra-violet filter box for use in experimenting with ultra-violet light. It consisted of a light tight box having a special glass front through which only the near ultra-violet rays could pass, shutting off practically all of the visible radiations. This box can be used in a very pretty experiment which should be performed with a carbon arc lamp set up in front of the glass.

It consists in exposing a doll, dressed in a fancy costume which has been painted with fluorescent substances to the action of the ultra-violet rays. When the little doll is placed in the box without the arc lamp going, one can see nothing. But when the arc is struck, the little lady stands out in much splendor, her clothes glowing with beautiful hues caused by the fluorescing of the substances used. Some of the substances which can be used here have been given previously.

Making Prince Rupert's Drops

By RAYMOND B. WAILES

The Prince Rupert's drops are made with a Meeker burner and are dropped into a beaker of cold water.

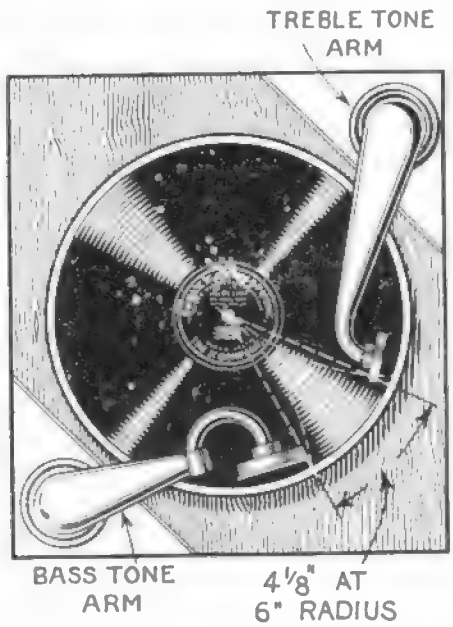
The drops will withstand heavy blows from a hammer.

The drops will explode with a loud report when the small tail is broken off with a pair of pliers.

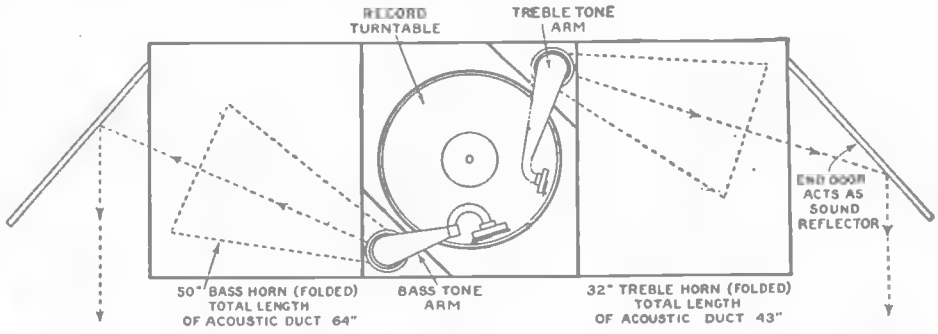
IF a piece of glass is melted and the drops are allowed to fall into water, the usual tendency for them is to shatter into a hundred pieces. With previous methods used in making Prince Rupert's drops, about two in every one hundred trials were successful. However, the writer has found a very successful method for making these drops, and uses a soft glass rodding, such as is used for stirring rods. Glass tubing can also be used. The glass is melted, as shown in photograph, by means of a Meeker burner, and the resulting drops are allowed to fall into a beaker of water. As these red-hot drops fall through the water they will usually break into many pieces with a hissing and a plop, but one out of every ten trials should result in the formation of a drop which does not break into pieces. These are perfect drops and will exhibit the unusual properties which are characteristic of strained or stressed glass. Glass usually breaks when struck with a hammer, but one of these perfect drops will withstand a hard blow, but it should be remembered to leave its tail alone. The least scratch or file mark made upon this glass tip will send the drop flying into a thousand pieces. The reason for this peculiar behavior is that the glass drop is under a terrific strain or stress when it is chilled by cold water. Molecular forces are at work waiting to free themselves from the skin of the glass on the outside of the drop. When the tip is broken, the stresses force the glass apart in hundreds of small pieces. It is advisable to demonstrate the shattering under a beaker or behind a sheet of glass. Sometimes the tail is very hard and can only be broken with the aid of a pair of pliers. These drops are termed Prince Rupert's drops or Dutch tears and exhibit unusual properties. They do not act as if made of glass, when subjected to several tests, although visually, the eye cannot tell the difference between them and the glass of which they were made. The glass rod should be held about three inches above the beaker of cold water, and sometimes it will be found that ten or twelve perfect drops can be made in succession.

A Duplex Phonograph

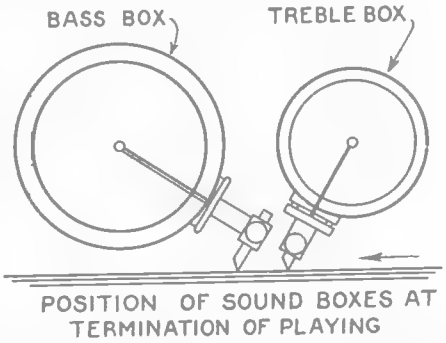
A UNIQUE duplex phonograph with many possibilities is shown here. This instrument employs two distinct sound boxes, two tone arms and horns. The straight tone arm on the phonograph is fitted with a small sound box and is connected to an amplifying horn approximately thirty-two inches long. The total length of the acoustic chamber is forty-three inches. The other tone arm has the gooseneck reversed and is provided with a large sound box. This is connected to a horn fifty inches long with a mouth diameter of eleven inches. The complete length of this acoustic duct is sixty-four inches. The two tone arms are pivoted in opposite diagonal corners. The object of the reversal of the goose neck will be clear upon examination of the drawing, and is done in order to keep the correct needle track alignment. The treble tone arm is of the straight type. The base tone arm has its needle trailing at an angle of sixty degrees with the record. An important feature of this arrangement is the production of a sensation described as sound spaciousness, or the stereophonic effect. This echo effect is a valuable feature in obtaining realistic reproduction. The two sound boxes are reproducing in cooperation, but a note is sounded in the treble box a fraction of a second before it issues from the bass box.—*Courtesy English and Amateur Mechanics.*



The above illustration shows the arrangement of the two tone arms, which are placed four and one-eighth inches apart at a six-inch radius.


RECORD TURNTABLE
TREBLE TONE ARM
END DOOR ACTS AS SOUND REFLECTOR
50" BASS HORN (FOLDED) TOTAL LENGTH OF ACOUSTIC DUCT 64"
BASS TONE ARM
32" TREBLE HORN (FOLDED) TOTAL LENGTH OF ACOUSTIC DUCT 43"

Both the treble-tone arm and the base-tone arm have separate folded horns, placed as shown above.



The above illustration shows the position of the sound boxes at the termination of the playing. The two tone arms are relatively close together.

How to make it

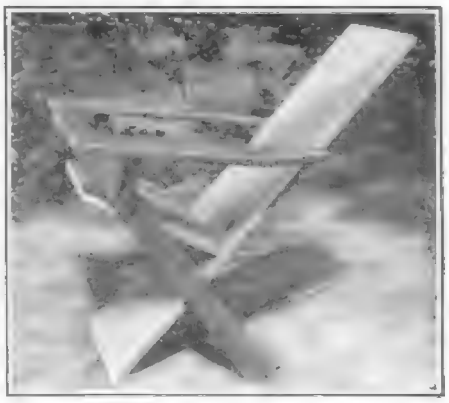
ARTICLES OF INTEREST TO EVERYONE

Making Drawings from Photographs

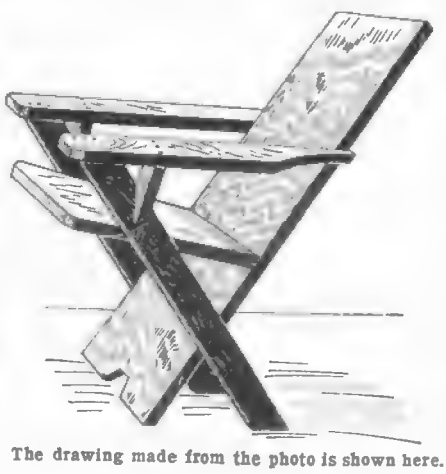
MANY times it is desirable to make your own drawings from photographs in order to show the constructional details of the article in question. The drawing is made with India ink upon the photographic print. After the drawing has been completed, the print is bleached in the following bath:

Hot water....10 ounces
Potassium
Iodide .....30 grains
Iodine..... 3 grains

The print should remain in the bath until the image has turned a blue-black and then placed in a fresh acid fixing bath, where it will become clear. It should remain in this bath for about twenty minutes, and then should be thoroughly washed in clear water. Blueprints may be made from this drawing by making the photographic prints or enlargements on a parchment paper which has the usual bromide emulsion. Ordinarily it will be found that the photographic print will have to be left in the bleaching bath from three to five minutes. This bath keeps well. —*Claude P. Fordyce.*



The original photograph is shown above.



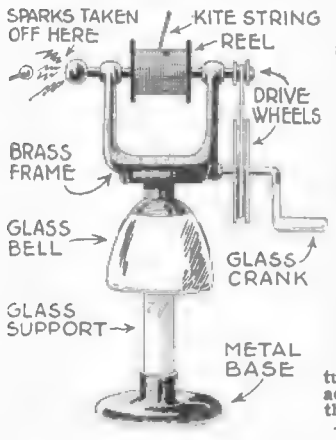
The drawing made from the photo is shown here.

SMOKE RINGS

Perfect smoke rings may be made with the apparatus shown above.

Smoke rings may be easily produced by filling a large can with smoke from a cigarette, pipe or cigar. A little ammonia poured into the can, followed by some concentrated hydrochloric acid will also produce a smoky vapor.—*O. Ivan Lee.*

KITE EXPERIMENT



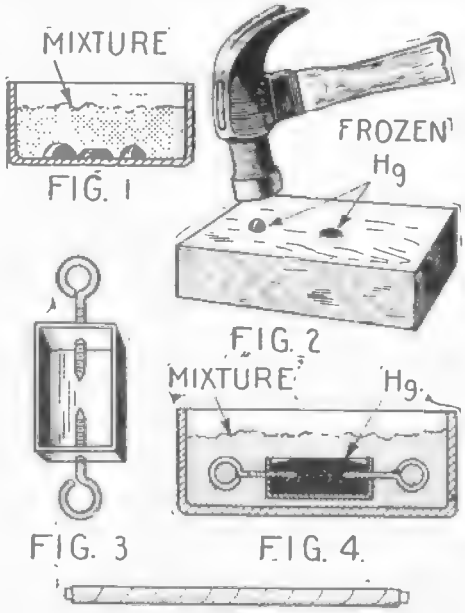
The drawing at the right shows the apparatus which was used by Franklin in his famous kite experiment which can be duplicated by anyone. The metal frame is insulated by a glass support and the kite string is reeled in or out with a glass crank. This apparatus is an exact copy of the original. —*J. H. Mote.*

HOW TO MAKE IT

articles should be short, descriptive, and include a sketch. Make sketches on separate sheet. Write on one side of paper only. Name and address on every sheet.

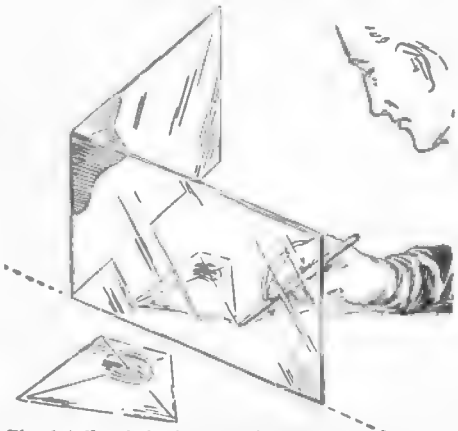
FROZEN MERCURY

Mercury is put in the bottom of a container and a mixture of three parts of calcium chloride and two parts of snow is placed upon it. This will produce a temperature of about 50° Centigrade, and will soon freeze the mercury. Fig. 5 shows cardboard tube used to freeze mercury in a solid rod.—*H. H. Sweets, Jr.*



The above drawing shows a number of experiments which can be carried out with frozen mercury, freezing mercury in box shown in Fig. 3.

COPYING DEVICE

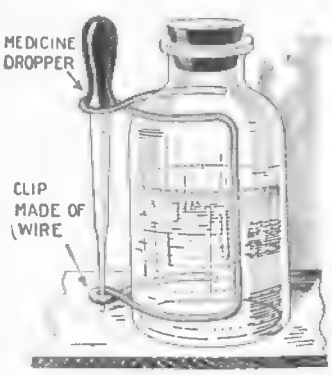


The details of the home-made copying device are shown in the above illustration.

If two rectangular pieces of glass are fastened perpendicular to each other, as shown, the device may be used for copying drawings. The reflection of the object is readily seen when viewed from the front. A corner cut from a cardboard box will serve to hold the plates together at right angles.—*D. Menzel.*

MEDICINE DROPPER CLIP

The illustration at the right shows a bottle clip for holding the dropper or pipette in place. Two loops are formed in a piece of wire, which clamps tightly around the bottle. The lower loop in the wire holds and supports the tip of the dropper, while the loop at the top receives the dropper loosely. —*Julius Mersand.*



Readers Forum

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them, whether caustic or not. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words or less, and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

SPIRITUALISM

Editor, SCIENCE AND INVENTION:

My purpose in writing this letter is to get a clearer conception of your views on the subject of spiritualism as related to psychic phenomena. In the $21,000.00 offer for spirits, you say ". . . to any medium or spiritualist who can present any psychical manifestation in so-called spiritualism that he (Dunninger) will not explain or that he cannot reproduce by natural means." . . . "to anyone who could demonstrate his or her ability to communicate with the spirits or to give some definite form of a physical demonstration which in itself was not trickery." Now, it appears to me that the wording of your offer is not without ambiguity, as no genuine medium (assuming there are such) could hope to fulfill the requirements. First of all, it is necessary to differentiate between psychic phenomena and spiritualism, as a strict interpretation of your offer involving $11,000.00 might conceivably be taken to mean any class of phenomena, such as mental telepathy, clairvoyance, clairaudience, externalized motivity, telekinesis, levitation, etc. It is generally known that such phenomena can be legitimately produced and that spiritualism is not particularly concerned in its explanation. But do you deny that these various forms of psychical manifestations ever occur except through fraud or trickery? As an example, let us consider the experiments of the late W. J. Crawford, whose book, "The Reality of Psychic Phenomena," excited considerable comment several years ago. Miss Katherine Goligher was the medium on whom the experiments were made, and I believe the most pronounced skeptic, after reading the book, will agree that the phenomena actually took place, but their spiritualistic origin is, of course, another question. Or let us consider the experience of J. Malcom Bird, whom the *Scientific American* sent on a mission for the purpose of investigating spiritualism several years ago. His book, "My Psychic Adventures," speaks for itself. D. D. Home, probably the most celebrated medium in history, produced the phenomena of levitation on numerous occasions. The following quotation is taken from a biographical sketch: "The accumulated testimony establishes Mr. Home's rising from the ground in the presence of as many separate persons; and I have heard from the lips of three witnesses to the most striking instance of this kind—the Earl of Dunraven, Lord Lindsay and Captain C. Wynee—their own most intimate accounts of what took place. To reject the recorded evidence on this subject is to reject all human testimony whatever; for no fact in sacred or profane history is supported by a stronger array of proofs." Years ago, Dr. Maxwell conducted a number of striking experiments in telekinesis and externalized motivity with Eusapia Palladino which were beyond question, free from fraud or deception, as an imposing array of proofs will show. That both Eusapia Palladino and D. D. Home resorted to deception in several recorded instances is a matter to be considered separately from those cases where such means are out of the question. In this connection we must consider that the power to produce such manifestations is not always present in even the most celebrated mediums, and that many have resorted to fraud and trickery when the ability to produce by legitimate means was absent. The average audience during a spiritualistic seance is inclined to be gullible and easily deceived. But when a group of scientific men, to whom we must accord the utmost respect and attention, publicly announce the genuineness of certain psychic phenomena observed under the most rigid and exacting tests conditions, we must think twice before shouting "fraud."

Referring back to Dunninger's offer, I find difficulty in its proper interpretation. Does he mean without reservation that $10,000.00 will be paid to any medium or spiritualist who can present any psychical manifestations in so-called spiritualism, or merely a psychical manifestation, that he cannot explain satisfactorily to everyone concerned, at the same time proving his explanation correct? Clairvoyance and telekinesis are considered by many individuals to be psychical manifestations in so-called spiritualism, and granting their genuineness as psychical manifestations and not spiritualism, what scientist who has made a painstaking study of the phenomena has ever set forth a satisfactory explanation? Many theories to account for their phenomena belonging in the domain of abnormal psychology have been advanced by such men as Sir Oliver Lodge, Camille Flammarion, Henry James, Dr. Maxwell, Sir William Crookes, etc., but these men of science would hesitate before staking their reputation on a "correct" explanation, because they themselves do not know, despite their many years of experiment and research. So I am writing this letter in the hope that you will further enlighten me as well as other interested readers, in this matter of psychic phenomena *versus spiritualism.*

ARTHUR O. HEIN,
Detroit, Mich.

(Our views on the subject of spiritualism and psychic phenomena are quite unbiased. We can enter upon any set of tests with a perfectly open mind and a willingness to believe, provided that it is proven, and provided that the manifestations are devoid of trickery. The editor disagrees with you entirely when you state that mental telepathy, clairvoyance, clairaudience, telekinesis, levitation, etc., can be produced. We do not believe that one single representation itemized by you can be effected without the aid of trickery. We deny that any of these various forms of manifestations are psychical in nature (spirits do not require prestidigitation), and we take your exact examples, namely, W. J. Crawford, who experimented with the Goligher circle. This group was caught in the act of trickery; so have D. D. Home and Eusapia Palladino indulged in it and been exposed. We will grant that the accumulated testimony establishing Mr. Home's levitations was overwhelming, but this overwhelming testimony was the result of Home's trickery of even his investigators. It was not until Eusapia Palladino came to this country, after having been introduced by Hereward Carrington, that she was exposed. If these mediums are so remarkable, they should never have resorted to deception. Employing deceit in even one instance is sufficient to discard the entire testimony in that medium's favor.

It sometimes takes a long time to catch a medium in trickery. A new trick is easily mastered, but it is uncovered with difficulty only. The argument that a medium capable of producing effects tricked because the audience was gullible and easily deceived or because she could produce, is indeed a poor one. Too often have scientific men placed their stamp of approval on mediums who were discovered perpetrating the most blatant of frauds. Would you commit a crime except for fear that you may be caught? No. Why then should the medium do so?

SCIENCE AND INVENTION Magazine means that it will pay a total of $21,000.00 for spiritualistic manifestations coming under its contest conditions, and that Mr. Dunninger will pay $10,000.00 to any medium if he cannot uncover the fraudulent methods by which the medium acts or duplicate the medium's effect.

Thus, one would not expect Mr. Dunninger to turn a double-back somersault in the air. He can explain that the thing was produced and undoubtedly tell how it was produced, but he could not duplicate the effect. Neither could one expect Mr. Dunninger to emit the voice of a child, an Indian guide, an aged woman and a foreigner. He could tell what was done and how it was done. This is what is meant by "will not explain."

As to the clairvoyance, telekinesis, mental telepathy, levitation, etc., they need no explanation. They simply do not exist.—EDITOR.)

AMAZING STORIES

IN OUR FEBRUARY ISSUE:

THE MASTER OF THE WORLD (a serial in 2 parts), Part 1, by Jules Verne. Nearly twenty years after writing "Robur," Jules Verne turned once again to the flying machine, and in 1905, the year of his death, this sequel to "Robur the Conqueror" was published. The inventive power of this aged master and his skill in conceiving and portraying a dramatic climax remained unimpaired in this story, even to the end. If anything, he exceeded himself.

BARON MUENCHHAUSEN'S SCIENTIFIC ADVENTURES. (1. I Make a Wireless Acquaintance; 2. How Münchhausen and the Allies Took Berlin), by Hugo Gernsback, in which the author introduces the wily Baron's "reincarnation" in a most amazing and outstanding manner. You will chuckle with glee over the entire series of the Baron's remarkable exploits, but you will gain plenty of good scientific instruction, too. These are the first instalments of THE scientific serial of the year.

THE REVOLT OF THE PEDESTRIANS, by David H. Keller, M.D. What will happen to us in centuries to come if we continue to ride in automobiles? It is a question which we may well ask ourselves. Our new author, who is himself a doctor, gives us a vivid picture with absorbing detail of the most unlikely results. Signs of the truth of parts of the story can be seen already in the larger cities.

THE FOURTEENTH EARTH, by Walter Kateley. Scientists have steadfastly maintained that there must be other inhabited planes besides our own. This author has woven a charming tale around his ideas where such planes might be.

And other stories.

APPROVES OF OUR POLICY

Editor, SCIENCE AND INVENTION:

I am very much pleased with the former two magazines which I have been taking, and I heartily approve of your fearless and unrelenting war on fakes of various kinds, especially those that prey upon the sick and afflicted, such as the "Ionaco."

I also look forward to and enjoy very much Mr. Gernsback's wonderful editorials in SCIENCE AND INVENTION. They are truly inspiring, and no doubt are doing their part in hastening inventions of the future.

Wishing you every success.

R. GUNNARSON,
Burbank, Calif.

(We wish to thank you very much for your kind wishes, which we in turn extend to you.

The readers of SCIENCE AND INVENTION Magazine can greatly help in the war on quacks by letting the editors of this publication know of their existence, where they are, what they do, or any information about them that the reader can get, without in any way inconveniencing himself. The editors do the rest.—EDITOR.)

MORE EXPOSÉS

Editor, SCIENCE AND INVENTION:

In your October issue I read the exposé of Ionaco, and believe you are doing good work in showing up some of the junk that is on the market.

At the end of the article you gave a call for more, and I believe that the enclosed clipping has all the signs of a come-along.

According to the ad, it is a cure-all for all radio ills, will do away with static by simply turning a dial (which is sure going some), and also increases the power of the set.

If you are able to look into it and find it as good as claimed, I would appreciate knowing this fact.

I remain as ever, a constant reader of SCIENCE AND INVENTION.

ADNA H. ALDEN,
Schofield Bks., T. H.

(We wish to thank you for the lead, and would advise you that we shall gladly look into this static eliminator. Of course, up to the present time, no static eliminator has actually appeared. When a real static eliminator will have been designed, you may rest assured that SCIENCE AND INVENTION or RADIO NEWS will be the first to describe it in detail.—EDITOR.)

DIDN'T FOLLOW FORTUNE TELLER'S ADVICE

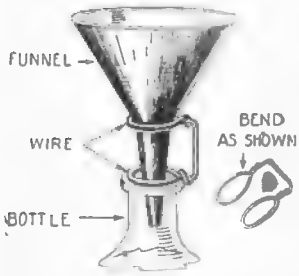
Editor, SCIENCE AND INVENTION:

In a logging camp here I came across an old copy of your May, 1925, issue of SCIENCE AND INVENTION Magazine and there read an answer to a correspondent's letter about having his fortune told. Here are a few things which I venture to tell of my own experience with a fortune teller.

About the 4th of July, over twenty years ago, when I was in Portland, Ore., taking a rest for a couple of weeks from hard work, I chanced to see the sign of a fortune teller stating that fortunes would be told for 10 cents. Somehow or other, I always had an idea that all fortune tellers are fakers and one could never trust them, but curiosity got the best of me and I had my hand read for 10 cents. My past and future was told to me, the former was true, the latter proved to be so later. I was informed that the next time I left the city for a job I would go north and come to a nice home, I should be prepared to stay there and be happy, and I was told to marry the man's daughter whose name was mentioned. For 50 cents more the fortune teller would have told me more things, but I felt that I had enough. Two weeks later, I chanced to hire out to a suitable job of building a new highway which happened to be straight north, some seventy or more miles from the city. I was one of a crew of men shipped out from the employment office. We were to stop at the Halfway House for dinner. Most of the men were broke and went on, so only I and the teamster had dinner with the farmer, who several times spoke about wanting a young man, and looked at me as though I were the right party. He needed somebody around the place. We were with the crew about two days and, as usual some grievance caused a strike to be organized and the men quit and walked off the job. That evening I returned to the Halfway House and asked the farmer if I could sleep in his barn, but he insisted that I stay in his house, and for that matter, stay with him and share what he had. He demonstrated to me his various assets and introduced me to both of his daughters, the name of one being identical with the name mentioned by the fortune teller. I am sorry today that in my folly of youth I decided to move on because it not only proved to be my misfortune, but their misfortune as well. I failed in everything, and the farm itself was sold for taxes, the old farmer having died in a

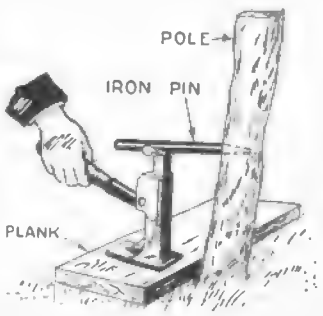
(Continued on page 930)

FUNNEL SUPPORT



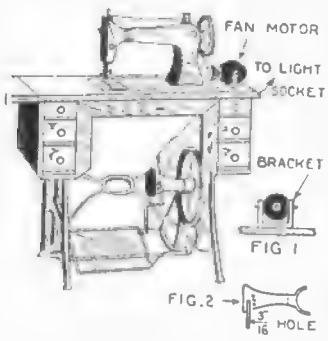
The arrangement at the left provides an air vent which allows the air in the bottle or jug to leave the bottle or jug without moving up through the stem of the funnel, impeding the flow of the liquid in the funnel stem. A piece of stiff iron wire is bent into two loops and slipped over the stem of the funnel. This method saves time and material besides eliminating the usual splattering of drops of liquid caused by air bubbling in the funnel stem.—Arthur Flinner.

POLE LIFTER



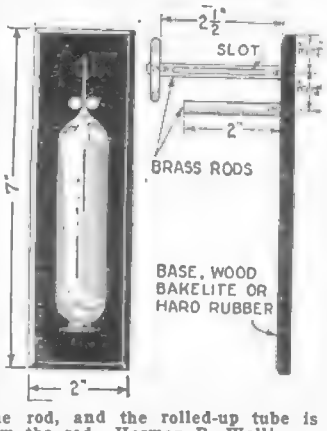
This method enables a person to take out a pole or a post without shoveling a hole around the base of the post. A strong iron pin is first driven into the post and an automobile jack is set on a plank directly under the iron pin. If the pole is set unusually deep, it may be necessary to remove and replace the pin at a lower point on the hole.—Charles H. Carr.

ELECTRIC SEWING MACHINE



The illustration shows a way to convert an ordinary sewing machine into an electric sewing machine. An old electric fan motor is used and the speed is controlled by the fan's rheostat. Fig. 1 shows how to mount the motor. Fig. 2 shows where to saw through the fan base. —William Seddn.

PASTE TUBE HOLDER



This holder provides an economical and neat means for removing tooth paste or shaving cream from its soft metal tube container. As can be seen in the sketch, the tube of tooth paste is slipped into the slot in the upper brass rod, and as the paste is required, the knob is turned. When the tube is empty, the knob is screwed off the rod, and the rolled-up tube is removed from the rod.—Herman R. Wallin.

SPECIAL HOES

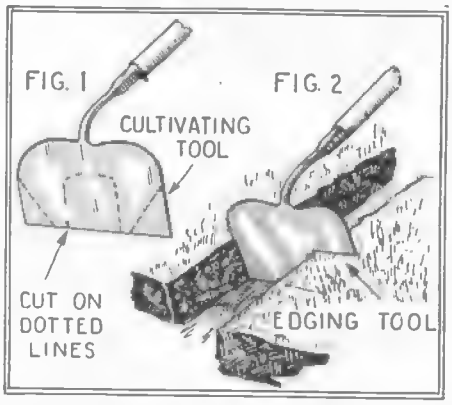
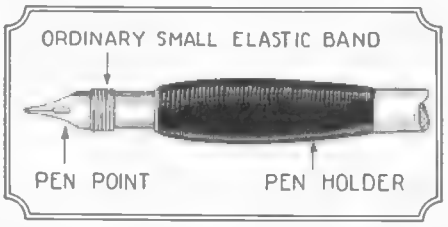


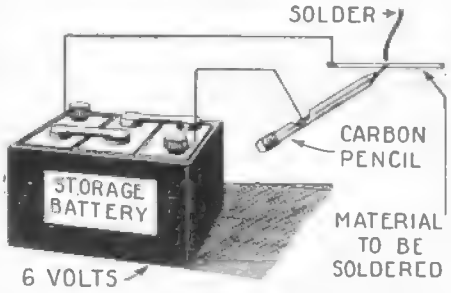
Fig. 1 shows how an old hoe should be cut to produce a garden tool which will permit cultivating both sides of a row of seedlings at the same time. Fig 2 shows the form used for a lawn edging tool.—Vernon Miller.

DRAFTSMAN'S LETTERING PEN



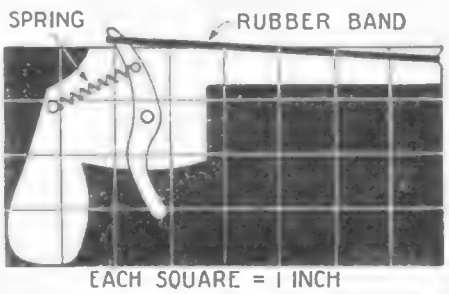
An ordinary elastic band is placed on the pen, as shown in the illustration. This arrangement provides an ink reservoir and printing may be done with less frequet redipping of the pen.—Leonard Keiser, Jr., Reporter No. 27612.

LEAD PENCIL SOLDERING IRON



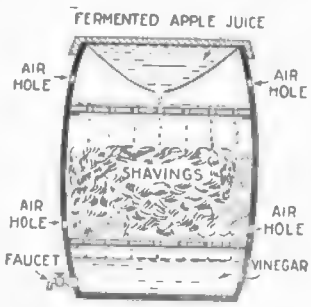
Small parts or wire may be soldered together with the equipment shown above. The shorter the pencil is the greater will be the soldering temperature, this must be adjusted by experiment.—Contributor send address.

RUBBER BAND GUN



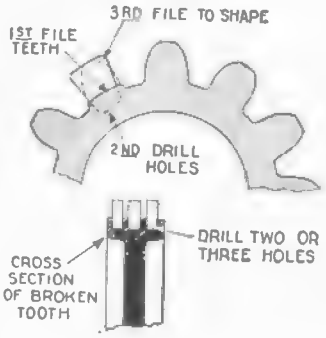
The construction of this toy is clearly shown in the illustration above. A gun of this type will appeal to parents, as it does not use buckshot or any explosives.—Henry Kawecki.

RAPID VINEGAR PRODUCER



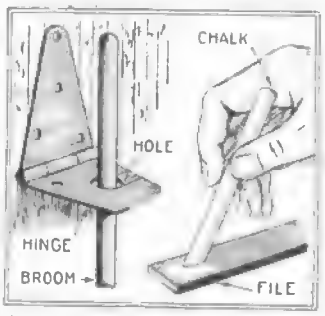
This arrangement produces vinegar in a few minutes by allowing fermented apple juice to drip slowly through beechwood shavings which have been inoculated with acetic acid bacteria by previously wetting them with vinegar. The shavings are held in a barrel which has a number of holes cut in it to admit a plentiful supply of air.—David Diamond.

GEAR REPAIR



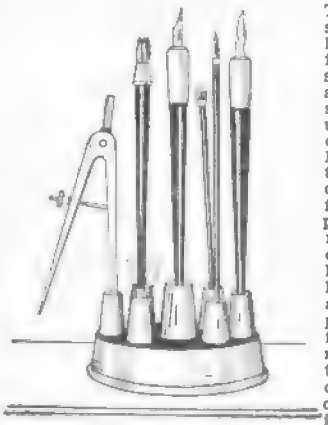
The broken tooth is filed flat and holes are drilled as shown. Round steel stock is hammered into these holes. The steel pegs are then filed to the shape of the other teeth. —S. Pacosa.

BROOM HOLDER AND FILE AID



The broom holder consists of an ordinary hinge with a large hole drilled as shown, in one wing. If a file is coated with chalk before filing steel, the chips will not stick in the cuts in the file and scratch the work, especially when filing on lathe work.—Vernon Miller.

BRUSH OR PEN HOLDER



The holder shown at the left was made from an old six cylinder automobile's spark distributor. Even the dirtiest bakelite distributor may be cleaned with fine sandpaper and varnished to produce a fine-looking brush-holder. This article is especially useful to draftsmen and artists, because of the number of implements it holds and the small desk space it occupies.—William F. Rodenkirchen.

Radio

Home Broadcasting a New Pleasure

New Device Attached to Any Radio Set Provides Much Amusement

The young lady in the above photograph is apparently listening intently to some far distant station. In the photo at the extreme right, we have a view of this "station," which is simply a microphone that is plugged into the detector socket.

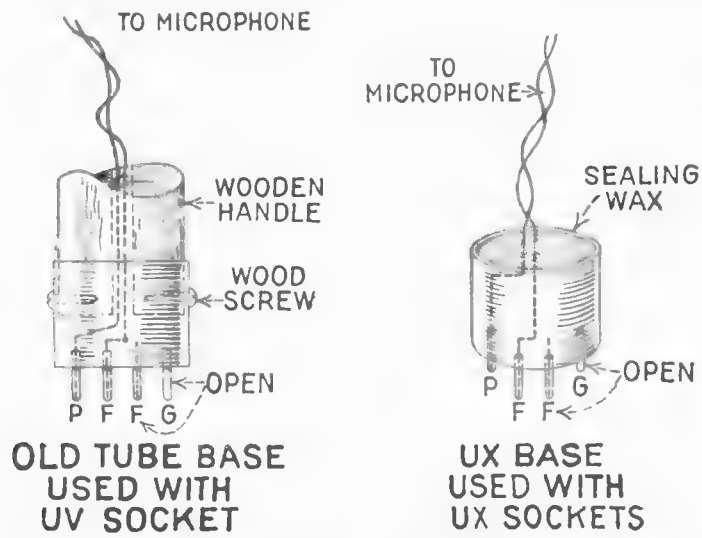
The photo at the right shows clearly the small microphone, which can be conveniently held in the hand. The device comes complete, with a special adapter which fits over the base of the detector tube.

The distant "station" to which the young lady was listening is shown above, and is located in the same house. A device of this nature has many possibilities for entertainment and there is no end to the novelties which are made possible. There are many other novel experiments which can be carried out and are further explained in the text.

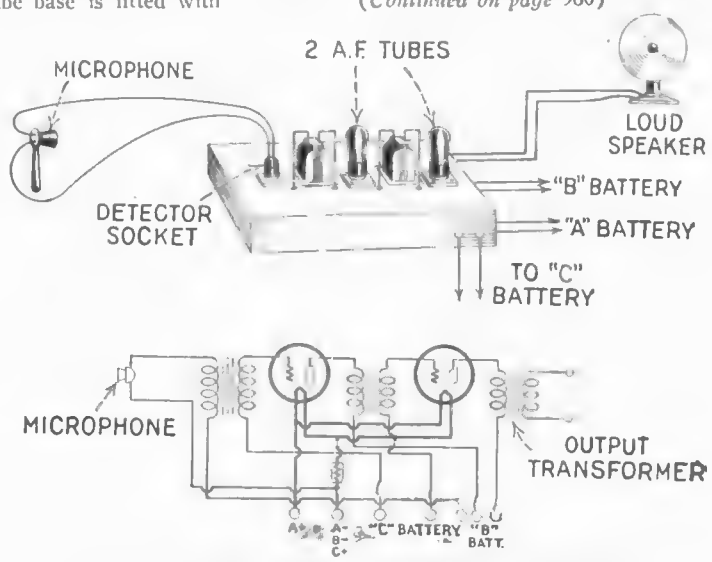
EVERY home can now have its own broadcasting station by using one of the new home broadcasting devices which have recently appeared on the market. The idea is an old one, but has never been worked out efficiently enough to make it practical at a low cost. The home broadcasting instrument is simply a microphone of efficient design which is plugged into the detector socket of the radio receiver and utilizes the audio amplifier. The microphone is placed in some room adjacent to the set and the wire leading to the microphone concealed under the rug or around the moulding of the room. As most receivers employ one or more stages of radio frequency, it will be necessary to remove these tubes from the socket entirely, as they are not used. The broadcasting units may be bought complete or the experimenter may make one himself. The only outlay will be the cost of the microphone, for the adapter which plugs into the detector socket can be easily made as shown in the drawing. For those still having the old UV sockets in their receivers, an old UV vacuum tube base is fitted with a wooden handle. The adapter for the UX socket employs a UX base and does not have to be fitted with a grip, although this may be found more convenient than if the base alone is employed. One of the filament prongs and the plate prong are connected to the microphone, while the other filament prong and the grid prong are left open.

There seems to be no end to the novelties made possible with this device. Microphone technique is one of those desirable assets that every artist must have, if his or her talent

(*Continued on page* 960)



The above illustration shows two methods of making adapters for a microphone, so that it may be plugged into the detector socket of the radio set.

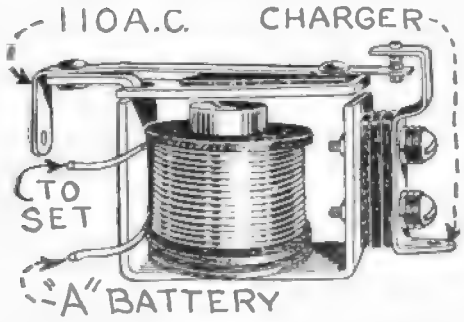


Above we have both a schematic and a picture diagram showing how the microphone is connected. The audio amplifier alone is used.

NEW RADIO DEVICES

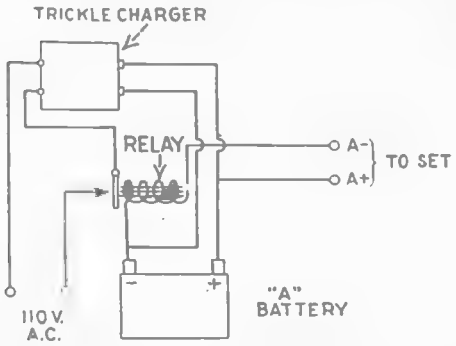
Accessories Recently Developed Which Will Improve Any Radio Set

RELAY SWITCH



The above drawing shows a view of the new relay switch which can be used in conjunction with any radio receiver employing a trickle charger.

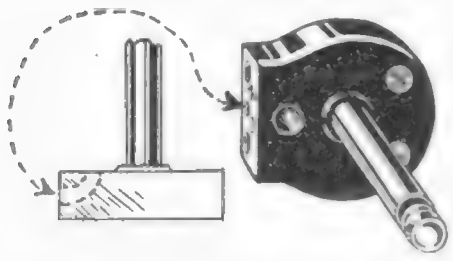
A NEW relay switch has recently been placed upon the market by one of the Chicago radio manufacturers. This device is connected as shown in the diagram, and automatically connects the charger with the



The circuit of the new switch is shown above. When the radio set is turned off, the charger is automatically connected with the line.
—Illustration Courtesy General Mfg. Co.

line when the set is turned off, and disconnects the charger when the set is turned on. The winding of the coil in the electro-magnet has a very low resistance and the relay will trip on .8 of an ampere of current. The instrument is finished in nickel, and is of a small size.

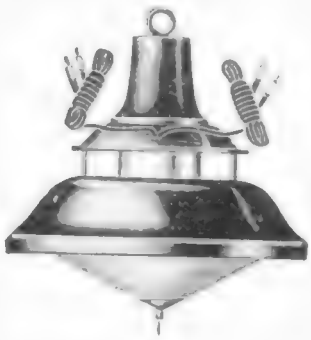
FLAT PLUG



The flat plug, which is a distinct improvement over the old style, is shown above. Note the extra hole through which the loud speaker cord is tied.
—Illustration Courtesy Carter Radio Co.

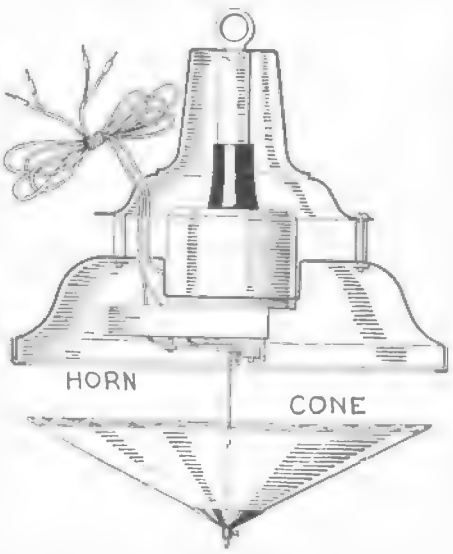
THE old type of radio plug had many drawbacks probably the largest of which was the fact that it projected two or more inches from the front of the panel. In order to obviate this nuisance, one of the largest manufacturers of radio parts has brought out a flat plug which fits snugly against the panel. The loud speaker or phone tips are inserted into two small holes on the bottom of the plug. A hole has also been provided so that the cord of the speaker or phones may be tied to the plug. If the cord is accidentally jerked, the tips will not pull out of the plug, or the tips pull loose from the cord. The plug itself is small, measuring only about two inches long, and fits snugly against the panel, projecting outwardly only about one-quarter of an inch. The flat end of the plug is made of black bakelite, with the polarity stamped upon it. The metal portion of this device has been nickel-plated.

HORN AND CONE SPEAKER



The combination horn and cone loud speaker may be seen above. It may be conveniently hung up by means of a small metal ring fastened to the top portion.
—Illustration Courtesy Osbeck Radio Light Co.

A NEW novelty has recently been brought out by a Brooklyn manufacturer. This is a combination horn and cone loud speaker. These two speakers may be used at the same time or either one used separately, as desired. The cone is placed in the bottom part of the speaker, the device, which looks something like a lighting fixture, can be suspended from the ceiling or other suitable support. The metal portion of the speaker has been finished in brown. The cone may be adjusted by means of a small tip placed on the end of the driving rod. The cross-sectional view shown below gives one an idea of the construction of this new speaker. This speaker is a distinct novelty and gives good reproduction.



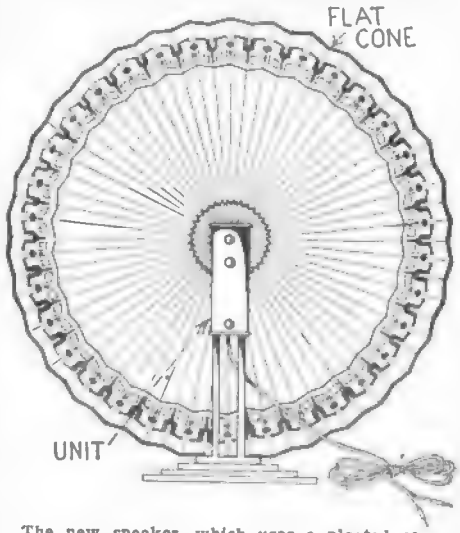
Above is a cross-sectional view of the speaker showing the placement of the horn and cone and also of the two loud speaker units.

CENTER TAP RESISTOR

A center tap resistor of unusual design is shown above. The resistance wire is enclosed in an insulating tube.
—Illustration Courtesy Electrad, Inc.

AN unusual center-tap resistor, which can be used to advantage with the A.C. tubes, has recently been placed upon the market. The resistance wire is enclosed in an insulated covering and the construction is such that this accessory takes up very little space.

NOVEL CONE SPEAKER



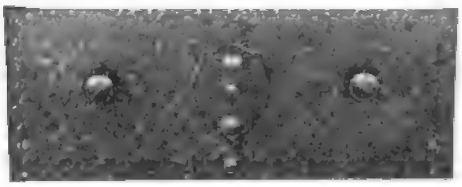
The new speaker, which uses a pleated cone resembling a fan, is shown above.
—Illustration Courtesy Fanspeaker Radio Co.

A NEW speaker, using a pleated cone, has recently appeared on the market and is made by a New York manufacturer. The cone may be readily dismounted and folded up into a small space when transporting the speaker. The fan portion is artistically decorated and harmonizes with the stand, which is of a dark brown color. The reproducing unit is of strong construction and will handle a large amount of power easily, without distortion. The stand is heavily weighted, so that the speaker will not be easily tipped over.

S. & I. 3-TUBE A.C.—D.C. SET

The First Part of an Article Describing the Construction of a Versatile Receiver for Battery or A.C. Operation

By PAUL WELKER



Above we have a front view of the completed A. C. D. C. receiver, showing the symmetrical front panel layout.

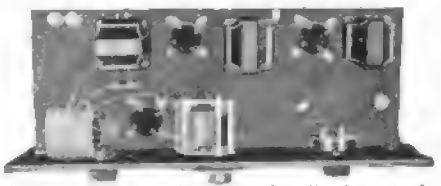
A TRULY versatile radio receiver, one which can be operated from the light socket or from the storage batteries, is shown upon this page. This, the first part of an article, will deal with the construction of the receiver, using standard storage battery tubes. The second part of the article will appear in the March issue of this magazine and will show how to change the set over for A.C. tube operation. Simplicity has been kept in mind in designing the receiver, and by changing a few wires, the set may be readily converted from storage battery to light socket operation. The circuit used is an ordinary three-circuit regenerative hook-up which is simple in operation and selective in tuning. No distance records are claimed for this receiver, but it will give fine reception on local and nearby stations.

ASSEMBLING THE RECEIVER

It was found that the parts used in the construction of this set could be fitted nicely onto a sub-panel measuring 7" x 16", with plenty of room left for the addition of an A.C. transformer if it is desired to use the new A.C. tubes. The three sockets, two audio-frequency transformers, and output impedance are mounted upon the top of the sub-panel as shown in the accompanying photograph. The grid leak and condenser and filament ballast are mounted upon the underneath side. A midget jack is placed on the right-hand side of the sub-panel The three-circuit tuner, variable condenser, volume control and filament switch are mounted on the panel as shown. It will be seen from the photograph that the front panel is well balanced with the main tuning control in the center. The detector socket is placed between the condenser and the coil, with the two audio sockets at the rear of the baseboard. The sub-panel is held to the front panel with two sub-panel brackets which may be either of metal or bakelite. The binding posts for the aerial and ground are mounted at the rear of the sub-panel, at the left-hand side. A small fixed condenser having a capacity of .001 mf. is placed directly across the primary of the first audio-frequency transformer. A volume control, a variable high resistance, is connected across the secondary of the last audio-frequency transformer. Since a power tube is used, it will be necessary to employ an output impedance or output transformer in order to protect the loud speaker windings. The output impedance is placed at the rear of the sub-panel at the extreme right, with the speaker filter condenser directly underneath.

WIRING THE RECEIVER

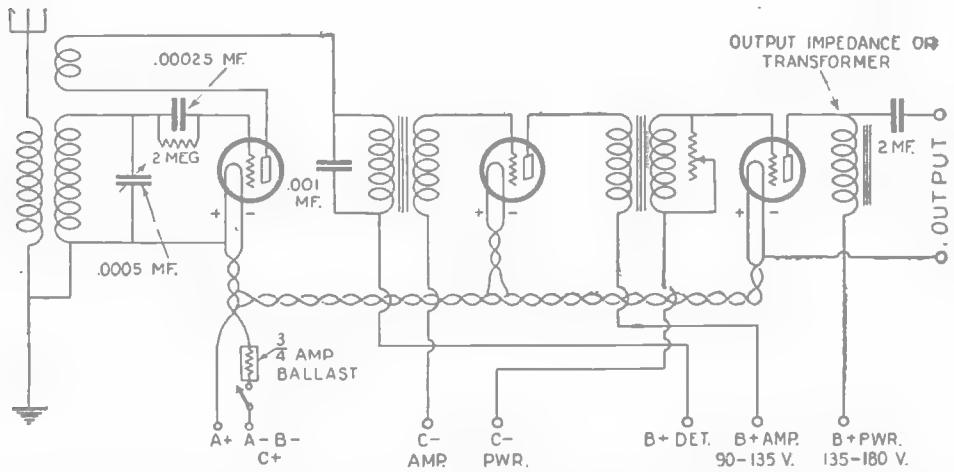
Before attaching the sub-panel to the panel, it is best to wire the audio-frequency end of the receiver and also the filament circuit, which should be cabled if the receiver is to be used with A.C. tubes. The battery cable may also be connected before the panel is attached. This cable is connected direct without the use of a plug. All wiring should be made as short and direct as possible. Wiring should be done with flexible hook-up wire, which may be obtained in different colors so that the various circuits can be easily wired and also easily checked in case of trouble. The photo shows clearly the sub-panel wiring and also the battery cable. The panel should be fastened to the sub-panel after all possible wiring has been done upon the sub-base itself. It may be well to mention in passing that a three-quarter ampere filament ballast is connected in series with the A—. This ballast is mounted beneath the sub-panel, as is the grid leak and condenser. After the sub-panel and panel have been fastened together, the rest of the wiring may be completed, bearing in mind to connect the rotor plates of the variable condenser to the grounded side of the circuit. A volume control, consisting of a high resistance, is placed across the secondary of the last audio-frequency transformer. This is situated on the right-hand side of the panel. The tuning condenser is placed in the center, with the filament switch underneath and the small coil at the left.



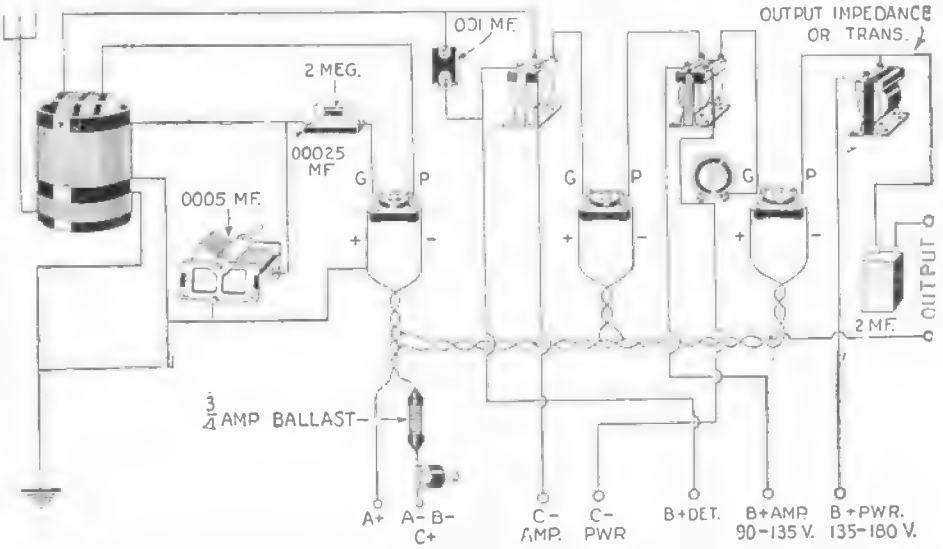
A view of the receiver, showing the layout of parts, appears above. The small midget jack is placed on the right-hand side of the sub-panel.

After the receiver has been completely wired, all connections should be carefully rechecked and with the tubes in their sockets, the A battery should be connected across the B battery wires in the cable. If the tubes light when the battery is connected in this manner, it is an indication of faulty wiring which should be remedied. If the tubes do not light, one can be reasonably sure that the filament circuit is O.K., and the set can be given its first tryout without fear of ruining the filaments of the vacuum tubes.

(*Continued on page 961*).



The schematic diagram of the set is shown in the above illustration. Notice that all of the filament circuit has been twisted so that the set may be easily changed over for A.C. operation. A variable resistance, which serves as a volume control, is placed across the secondary of the last A.F. transformer.



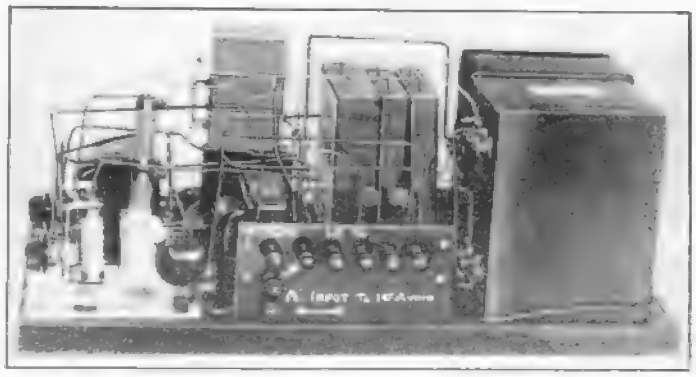
The picture diagram showing the hook-up of the receiver is shown above. When using a power tube, it is necessary to employ an output impedance or output transformer.

HAYDEN DELUXE

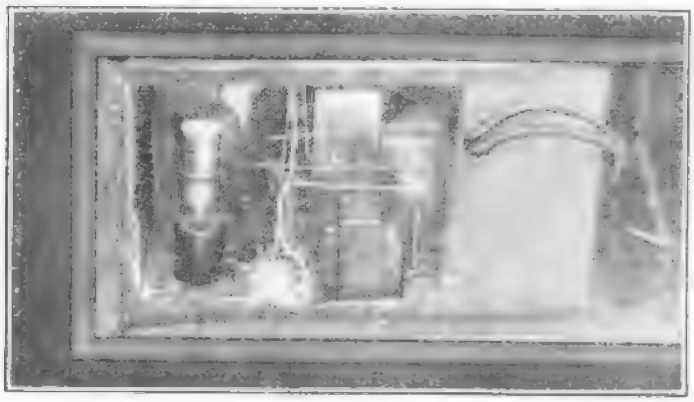
By HERBERT

In Which the Author Describes the Construction of a Power

THE DeLuxe power pack has been especially designed for use with the Hayden DeLuxe Super which was described in the January issue of this magazine. This power pack reproduces every musical instrument with unusual fidelity and has a remarkably wide tonal range. The power pack will provide additional amplification for the radio receiver or will replace the old audio amplifiers of the older sets with a power unit providing the finest possible quality of reproduction and will also furnish B power to the receiver. The entire unit is operated from any lighting circuit using 110 to 115 volts A.C., at 50 to 60 cycles. This unit uses two half-wave rectifier tubes of the 216 or 281 type, and their use is recommended wherever expense and practical considerations will permit. A single-wave rectifier will invariably produce more hum and less power than will a double-wave rectifier. An average power pack consisting of a single 210 power tube and a single half-wave rectifier will not, under average operating conditions, allow of maximum advantage to be taken from the inherent possibilities of the 210 tube due to the fact that the rectifier system cannot deliver sufficient voltage under operating conditions to allow the 210 to develop a greater undistorted power output than would be obtained from a 171 tube operating at about 180 volts.



At the right we have a photograph of the power pack, showing the binding post strip and placement of parts. All wiring has been done with No. 14 insulated hook-up wire. The three 2-mf. filter condensers may be seen standing just to the left of the power transformer. The power pack has been built upon a wooden baseboard so that it may be easily installed in the console containing the receiver.



The completed power pack installed in the bottom compartment of the console is shown at the left. A screen has been placed over the back to allow for the dissipation of the heat which is generated by the tubes. If this is not done, there is a possibility that the filter condensers may become injured. These condensers contain wax and if this becomes melted, there is a danger of a breakdown occurring.

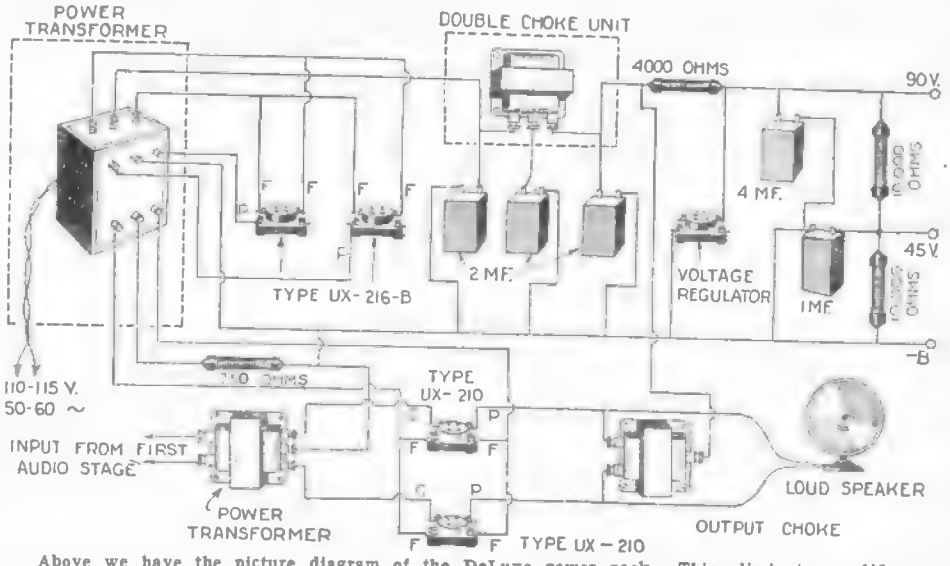
ASSEMBLY OF PARTS

The various parts should be mounted on the baseboard in accordance with the photographs shown on these pages. This layout, of course, does not have to be strictly adhered to, but was found to be the most convenient. The power transformer and double choke unit are mounted on one end of the baseboard, then the three 2-mf. filter condensers, the input transformer and output impedance. The six sockets are placed on one side of the baseboard and the binding post strip on the other. If desirable variable resistors may be used in place of the fixed ones shown in the diagram, so that a greater range of voltages may be obtained. The wiring of the unit may be easily done by following the schematic and pictorial diagrams. All wiring should be done with heavy, well-insulated wire and the ends soldered to lugs or fastened under terminal screws where possible.

TEST AND OPERATION

After the power pack has been assembled in accordance with the preceding paragraph, and the wiring and assembly carefully checked with the photos and the diagram, it is ready for test. The plug from the power transformer should be fitted into the light socket and the current turned on. The voltage regulator tube should be inserted and then the two power tubes. The filaments of these two tubes should light if the connections are all right. The rectifier tubes should now be inserted in their sockets. Immediately upon insertion, they should light, and the glow tube should emit a pinkish discharge. This power pack will furnish "B" potential to any receiver requiring 45 and 90 volts. Simply connect the leads from the receiver to the properly marked binding posts on the power pack. The two unused contacts of the glow tube socket employed, marked P and + are short-circuited in the tube base and may be used as a safety switch to cut off the power upon removal of the glow tube. The switch may be utilized by breaking one side of the power-transformer cord and connecting the two ends of the cut cord to the + and P of the glow tube socket.

If all the tubes fail to light, the fault may be attributed to a defective power transformer primary circuit probably to cord and plug or light socket. Should the amplifier and rectifier tubes fail to light trouble may be traced to the filament wiring of the power transformer. It should be borne in mind that the tubes themselves will not light if they are defective and have broken filaments. Should the glow tube fail to glow, this may be caused by improper connections, broken down condenser bank, defective resistance units, or defective rectifier tubes. Resistance units and condenser bank may be tested with a pair of headphones and a battery. In operation, the power transformer may become warm and the rectifier and amplifier tubes too hot to touch. This heating is normal, but under no circumstances should the power transformer become too hot to touch, nor should the plates of the amplifier or rectifier tubes become red. If the rectifier tube plates become red hot, this trouble may be attributed to broken down condenser bank or improper connections. The voltage output in the power pack may be measured with a suitable high-resistance voltmeter. The voltage between the B— and B+90 binding posts will be approximately 90, as this value is held constant by the glow tubes. The voltage between the B—

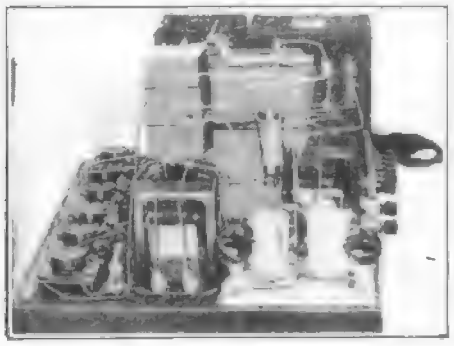


Above we have the picture diagram of the DeLuxe power pack. This eliminator-amplifier uses two type 210 power tubes, hooked up in push-pull style. Two type 216-B or 281 half-wave rectifier tubes are used.

SUPER "POWER PACK"

HAYDEN

Pack To Be Used with the DeLuxe Super Detailed Last Month



Above we have an end view of the power pack showing the six tube sockets which are placed on the left-hand side of the baseboard.

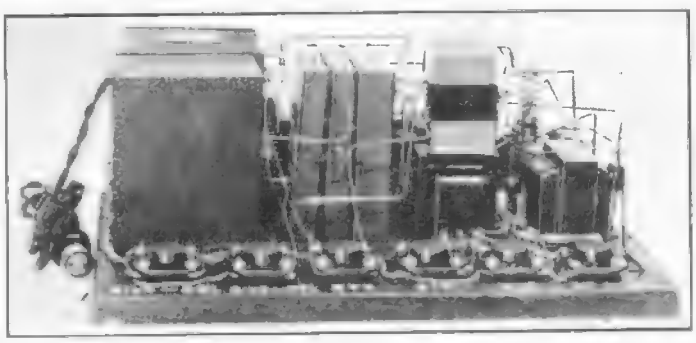
and B+45 posts will be between 45 and 53 volts at no load, as measured by a high-resistance voltmeter. Should howling be experienced in operation, it may properly be eliminated by moving the loud speaker some few feet away from the receiver, if it appears to build up slowly from inaudibility to maximum intensity; or the use of an anti-howl detector tube cap will help.

USES GLOW TUBE

The DeLuxe power pack uses a voltage regulator, or, as it is known by its rather descriptive name, the "glow tube." This tube is a device which is connected across the 90-volt output of a "B" power supply unit and maintains that voltage at a constant value, regardless of any variations in the load applied to the power unit. Without the use of this regulator, the voltage supply will fall off rapidly as the current drain is increased. By using a tube of this type, it is possible to construct a B-power unit, the 90-volt tap of which will deliver that voltage at all times, regardless of the number of tubes used. The action of the tube in holding the voltage of the output circuit constant serves also to eliminate any small ripples which may be present. When in operation the tube has many characteristics in common with a large filter condenser. One of these properties is extremely low A.C. impedance which, when combined with the characteristics of a voltage regulator, entirely eliminates the "motorboating" effect which usually results when an attempt is made to use B-power units with many forms of amplifiers. The voltage regulator tube results in a saving of the number of high-voltage fixed condensers required. This tube cannot be used with the average run of socket power supply units, due to the extra load which it imposes upon the rectifier and filter chokes. However, the power unit described here employs chokes capable of handling at least 85 milliamperes of direct current without core saturation. These chokes are encased in metal.

PARTS USED

A heavy-duty power transformer is used, one which will provide A, B and C current for a push-pull amplifier using two 210 power tubes. Two 216 B or 281 type rectifier tubes are employed, giving a full-wave rectification providing a total output current of 130 milliamperes. The choke unit used is one of the double type, which consists of two individual chokes of 30 henries each, which are enclosed in a metal case. The input transformer shown in the photographs is completely shielded and has a center-tapped secondary. It is designed to couple a stage of straight audio to a push-pull stage. The speaker is coupled to the output through a center-tapped choke, which has 30 henries inductance on either side of the center tap. This is sufficient capacity for the output of the two power tubes. No output condensers are required, as the speaker leads are at the same D.C. potential. The resistors used provide plate voltage of 45, 90 and 400, and a grid bias for the power tubes. If this power pack is intended to be used with your present receiver, it is recommended that a power input plug be used. This device connects the output of the receiver to the input of the amplifier and eliminates the necessity of any changes in wiring of the receiver.



Another view of the power pack is shown at the left. Note the placement of the filter-condensers, choke unit, input transformer, and output choke. The two half-wave rectifier tubes are placed in the first two sockets reading from left to right, next the voltage regulator tube, then the 210 power tubes and lastly the first audio tube. The binding post strip is placed upon the opposite side of the baseboard from the row of sockets.

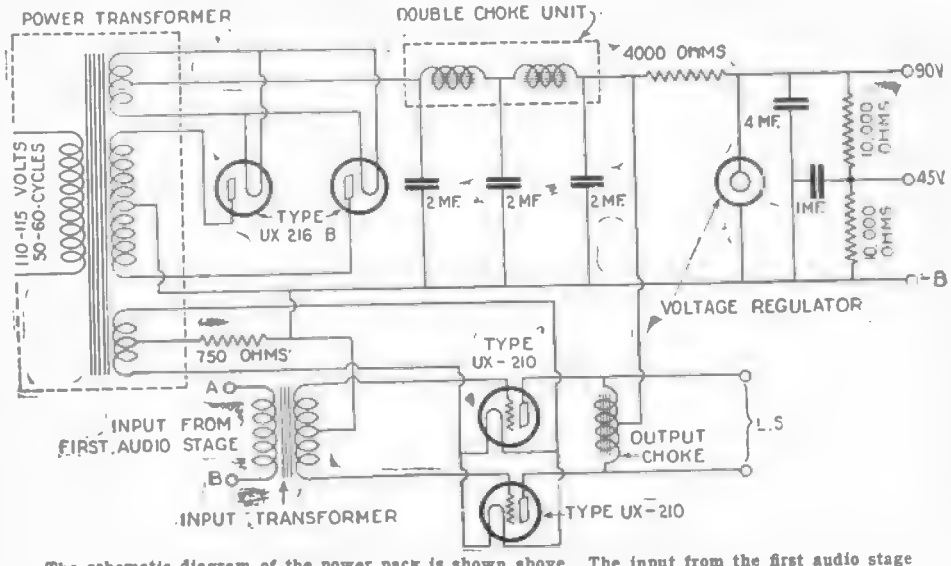
LIST OF PARTS

1 power transformer.
1 double choke unit, or two single chokes, 30 henries each.
1 low ratio audio transformer.
1 push-pull input transformer.
1 push-pull output impedance.
2 10,000-ohm resistances.
1 4,000-ohm resistance unit.
1 750-ohm resistance unit.
3 2-mf. 800-volt test filter condensers.
1 4-mf. 400-volt test filter condenser.
1 1-mf. 400-volt filter condenser.
8 binding posts.
2 type 216-B or 281 rectifier tubes.
2 type 210 power tubes.
1 voltage-regulator tube.
7 cushion sockets.

Names of manufacturers of parts for the DeLuxe power pack will be supplied free upon request.

TOOL LIST

Pliers, several kinds.
Screw-drivers, several sizes.
Hammer, hacksaw and blades.
Hand drill.
Twist drills, several sizes.
Scriber.
Center-punch.
Soldering iron, electric or other type.
Wire solder, self-fluxing or plain solder and non-corrosive flux.
Rule, steel or wood.
Center finder for dials.
1 three or four-cornered reamer and handle for expanding panel holes for shafts, jacks, etc.
Small tool and awl handle very useful.
Volt and ammeters for testing set, batteries, etc.
1 countersink.



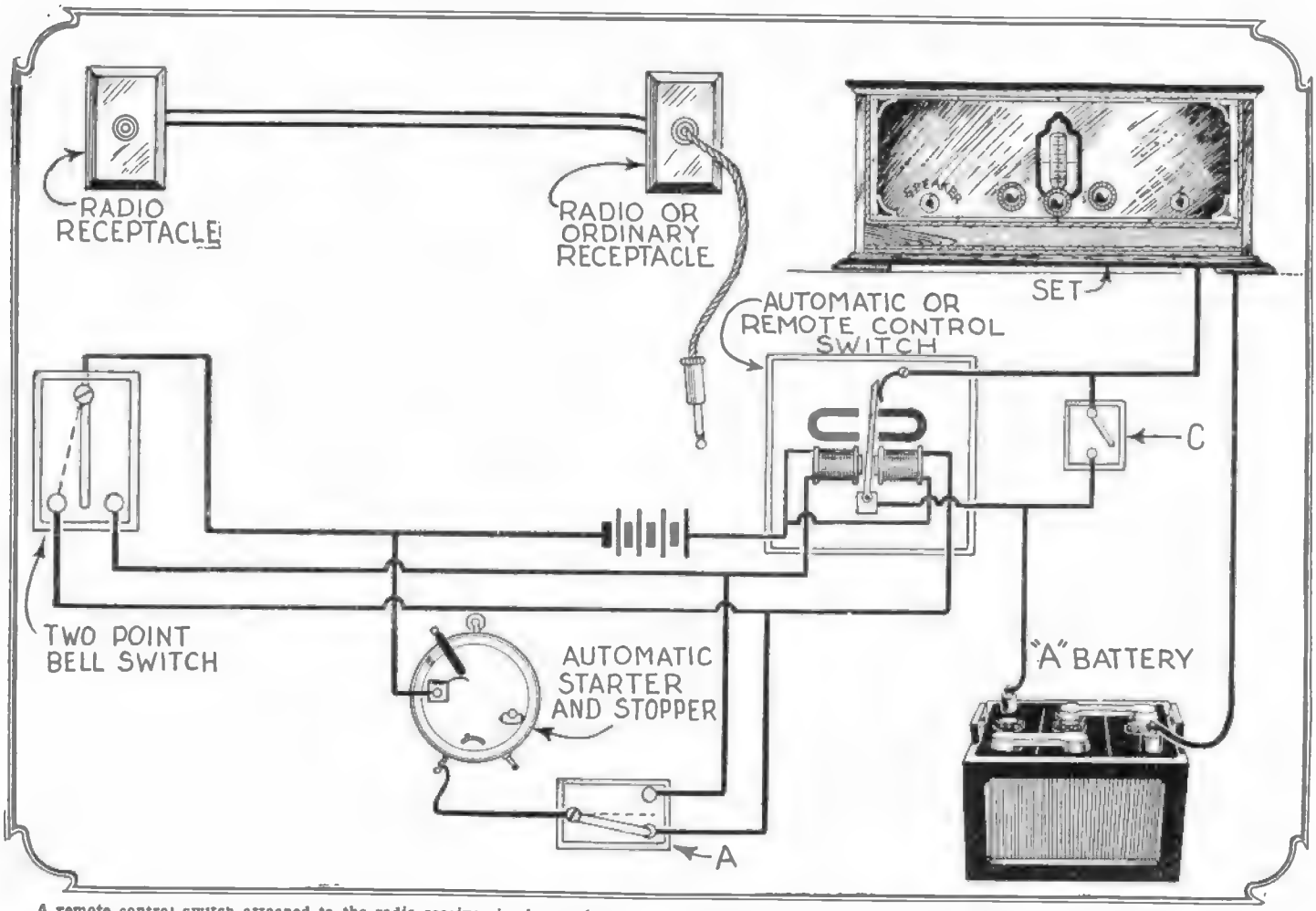
The schematic diagram of the power pack is shown above. The input from the first audio stage is connected to wires marked A and B.

If the power pack is intended for use in conjunction with the DeLuxeSuper, it should be installed in the bottom compartment of the console. A wire screen should be placed over the back of the console in back of the power so that the heat generated will not injure the condensers. If the pack is used in conjunction with the present radio receiver, it should be housed in some suitable cabinet, preferably of metal, or a wooden cabinet may be used. Gaseous rectifiers may be used in place of thermionic type, with slight changes.

Remote Control for the Receiver

By JACOB SCHMIDT

Simple Home-made Device Controls Receiver from a Distance

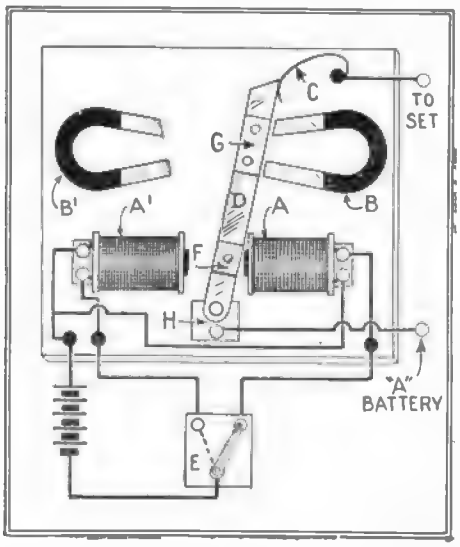


A remote control switch attached to the radio receiver is shown above. The wiring and arrangement of the system are clearly visible.

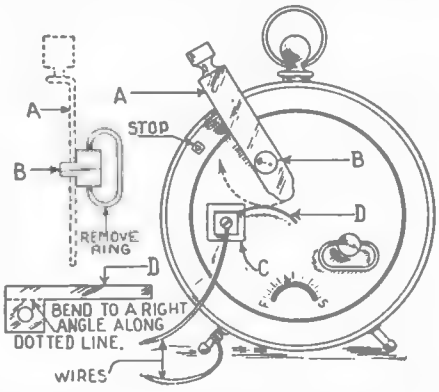
With the arrangement shown above one can listen in while in bed and set clock for stopping set at night, or starting in the morning.

MANY a radio fan has undoubtedly often wished that he might be able to listen to his radio receiver while lying in bed, and to start or stop the set automatically, without leaving the sheets. The device described here will enable the listener to have just such a convenience and in case he falls asleep without stopping the set, the clock will take care of it. The radio fan may even have the pleasure of being awakened by health exercises or music.

The wiring diagram and arrangement of the whole system is shown in the large illustration on this page. The two small drawings show the remote control switch and the clock. The switch is constructed as follows: A brass strip D about six inches long is fastened loosely by means of a bolt to one end of plate H. Two electro-magnets A and A1 are mounted on both sides of this. Two permanent magnets are fastened about an inch above these as shown.. C is a piece of thin spring brass which touches strip D when it is attracted by the magnet. The electrical connections are made to C and H. Strip D has two iron pieces F and G attached to it. When the lever on switch E is moved to the right electro-magnet A attracts strip D. The alarm clock should be fitted with a thin brass strip which is attached to the lid and is insulated therefrom. Another piece of brass about four inches long is fixed to the alarm wind as shown in the illustration. Since strip A is soldered to the key, it will be found that whenever the clock starts to ring, it will turn on its axis which is key B, and while it turns the lower end will move in the direction indicated by the dotted arrow in the drawing. Strip A will thus pass over strip D and make an electrical connection of short duration, enough to make the remote control switch start or stop the set according to the position of lever on switch A in the large illustration. In order to set the clock, turn strip A counter clockwise. The radio receptacle and switch B may conveniently be placed in the bedroom, and the remainder of the apparatus in the cellar. In order to operate the device, first tune in a station, set clock to the desired time and set switch A to the right if set is to stop and to the left if it is to start in the morning. If the remote control switch is not used, throw in switch C and the set will operate as usual.



The circuit diagram of the remote control switch is shown above. To stop the operation of the set the lever of switch E is moved to the left.



The alarm clock, which is the heart of this remote control system, has a thin brass strip fastened to the lid, insulated therefrom with a piece of mica. Another piece of brass is attached to the alarm winding key as shown in the above illustration. Strip A is soldered to the key.

RADIO ORACLE

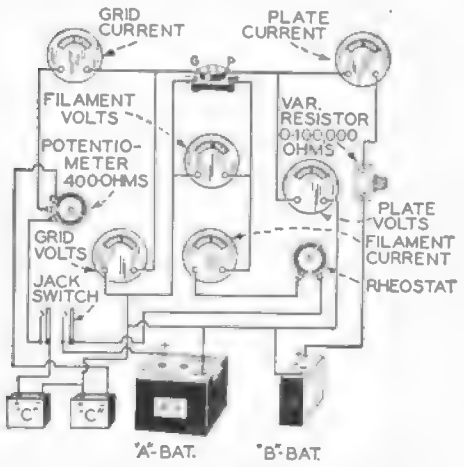
In this department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.

TUBE TESTER

(604) The International Radio & Repair Organization, Chicago, Ill., writes:

Q. 1. Will you kindly furnish us with a diagram showing the hook-up of a tube tester with meters for obtaining all of the important characteristics of the vacuum tube under test?

A. 1. On this page you will find illustrated a diagram showing a tube tester with meters for giving all readings. From the readings obtained it is possible to calculate the tube's plate resistance, amplification factor, and mutual conductance. The grid voltmeter should be of the zero center type, having as great a range as the maximum "C" battery voltage to be used and should be of the highest possible resistance. The other meters should also read as high as the highest voltage used. The



The hook-up of the vacuum tube tester is shown in the above illustration.

potentiometer may have a resistance of about 400 ohms, and is placed across the "C" battery so that a negative or positive bias can be obtained. The switch shown should be of the double pole single throw type, so that both the "A" battery circuit and the "C" battery circuit are opened, otherwise the "C" batteries will discharge through the potentiometer. The resistor in the plate circuit should be of the variable type, giving a resistance up to 100,000 ohms, so that the plate voltage may be changed without changing the "B" battery connections. The rheostat should have a resistance suited to the tubes to be tested. Additional switches may be placed in the tester so that any of the voltmeters may be open circuited by opening their switch or any of the ammeters short circuited by closing their switch. This instrument will also make tests of filament emission, grid current, positive grid voltages, and the effect of filament voltages on filament currents.

REJUVENATING VACUUM TUBES

(605) N. O. Siegel, Nashville, Tenn., writes:

Q. 1. Will you kindly tell me what types of vacuum tubes may be benefited by rejuvenation?

A. 1. Overheating the filaments of tubes whose filament wire is of the thoriated type will cause the rapid evaporation of the surface layer of thorium. The electron emission of the tube will then be only a fraction of its proper value and very little plate current will be had. Usually fresh thorium may be brought to the surface by heating the filament, but during the heating it is necessary that the plate voltage be cut off from the tube. There is additional thorium distributed through the metal of the filament and it is often possible to form a new surface layer from this reserve supply, so that the tube will operate as well as when new. Restoration is of value after the tubes have been in normal operation for long periods of time. If the thorium content of the filament has been used up almost entirely any improvement made by the restoration process will be temporary only. If through accident high voltage has been applied to the filaments only for an instant it is quite possible that they may not have burnt out, yet the tubes remain dead so far as detecting or amplifying signals are concerned. Under such conditions restoration is entirely practical. It must be remembered, however, that this treatment can only be used on tubes whose filaments contain thorium. It cannot be applied to tubes having plain tungsten filaments nor to tubes having oxide coated filaments. Plain tungsten filaments are found in the older tubes which use 1 ampere of filament current such as those in the 200 and 201 series. Oxide coated filaments are those which operate at very low temperatures, at a dull red or dull orange heat. These include such tubes as the 11 and 12 types, the 112 and 216-A. Thoriated filaments are found in most of the voltage and power amplifying tubes, such as the 201-A, 171, 210, 199 and 120 types. Thoriated filaments are also found in the 200-A type detector tubes. Any of these above mentioned tubes having a thoriated filament may be subjected to the process of restoration, usually with good results.

ELECTROLYTIC CONDENSERS

(606) J. C. Stone, Butte, Montana, asks:

Q. 1. Will you kindly tell me the critical voltages and formation voltages with aluminum plates in an electrolytic condenser of high capacity and also give some construction hints?

A. 1. An electrolytic condenser of high capacity can be made by immersing aluminum, magnesium or tantalum plates in some electrolyte such as a solution of sodium and ammonium sulphate, of ammonium citrate, of potassium permanganate or of various other salts. This type of condenser is well known among electrical engineers as the Mershon condenser and has been used in crude form by amateur radio operators for years. The choice of electrolytes is somewhat dependent upon the voltage at which the condenser is to be operated. The critical voltages for various electrolytes is given in the following table:

CRITICAL VOLTAGES

Sodium Salphate	40 Volts
Potassium Permanganate	112 Volts
Ammonium Chromate	122 Volts
Potassinm Cyanide	295 Volts
Ammonium Bicarbonate	425 Volts
Sodium Silicate	445 Volts
Ammorium Diphosphate	460 Volts
Ammonium Citrate	470 Volts

This critical voltage is the maximum at which the condenser will stand without a large leakage current. With the aluminum condenser capacity varies inversly as the voltage. This means that if the voltage is doubled the capacity is halved. A list of formation voltages is given here:

VOLTAGE OF FORMATION

50 Volts	14.2 MF. Per Sq. In.
100 Volts	5.1 MF. Per Sq. In.
200 Volts	2.58 MF. Per Sq. In.
400 Volts	1.29 MF. Per Sq. In.

When a strip of aluminum is immersed in a solution of ammonium phosphate an oxide film is formed. Thus we have a pair of conductors with their surface relatively close together but separated by a di-electric which has a very high resistance. In passing from a lower to a higher voltage the thickness of the gas layer increases and arrives at a new value in a few minutes. However, in going back to a lower voltage, it takes many months before the thickness of the layer reduces to its first value. Thus the capacity is not the same with reversed currents. To have equal capacities both ways, both of the condenser plates must have equal areas and must be formed at the same voltages. In a condenser of this type the anode (positive) is made of a very large metal surface so as to get as great a capacity as possible. As an electrolytic condenser will arc violently from exposed metal to surface of electrolyte, the anode is carefully covered with insulating material from just below the surface of the electrolyte to its terminal binding post. A layer of oil prevents evaporation. Remember that the film di-electric can be healed after a puncture, as the gas will form again.

BATTERY ELECTROLYTE

(607) G. B. Daniels, Ilion, New York, asks:

Q. 1. Can you give me some information regarding the renewal of solution in Edison cells?

A. 1. The potash electrolyte in Edison cells has a normal specific gravity of 1.200 at 60 degrees F. at the normal level. Throughout the total useful life of the cell, the electrolyte gradually weakens and may need renewal one or two times depending upon the severity of the service. The low limit specific gravity beyond which it is inadvisable to run an electrolyte is 1.160. Running a battery with electrolyte of lower specific gravity than 1.160 will produce sluggishness, loss of capacity and rapid breakdown on severe service. When ready to renew the solution, discharge the battery at normal rate to zero and short circuit for one or more hours. Then pour out half the solution, shake the cell vigorously and then empty. Do not rinse the cells with water, use only the old solution. Immediately after emptying each cell pour in the new solution to the proper height.

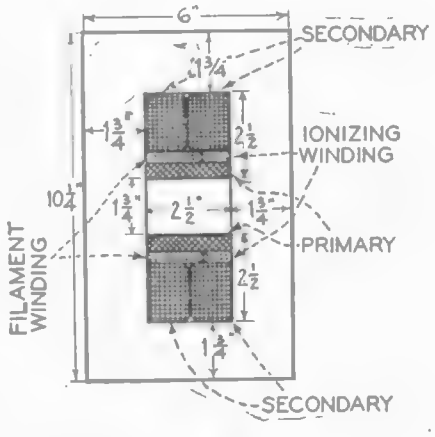
It may be necessary to add some more electrolyte after the cells have been standing, as some may have been absorbed by the plates. For replenishing any solution in these cells during operation, use pure distilled water. Do not allow the level of the solution to drop below the tops of the plates. It is important that the height of the electrolyte does not exceed the proper level. If filled too high, the solution will be forced out during the charge. The cells should never be allowed to stand empty for any length of time. When the new electrolyte has been put in the battery it should be given an overcharge at the normal rate.

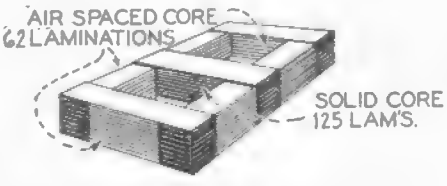
POWER TRANSFORMER

(608) Jack Richman, Jackson, Mich., asks:

Q. 1. Will you kindly inform me through the Radio Oracle how to build a power transformer to supply A, B, and C voltages to be used with a 400 milliampere rectifying tube?

A. 1. On this page you will find an illustration showing the construction of the transformer core and also the placement of the filament, ionizer, and secondary windings. The core is made of No. 28 sheet silicon steel .014 inch thick. 62 laminations 2½"x1¾", 186 laminations 6"x1¾", and 125 laminations 10¼"x1¾" will be necessary for the





Above we have the details of the power transformer, showing assembly of core and windings.

core. The center leg of the core should be assembled from the 62 laminations. This should be placed in a vise and tightly bound together with tape. The primary winding which consists of 160 turns of No. 14 D.C.C. wire is wound on a wooden form, securely taped, and then slipped over the center leg of the core. Rice paper should be placed between each layer of the winding and a layer of empire cloth should be placed over the completed primary winding. The filament winding consists of 10 turns of No. 12 D.C.C. wire and is wound over the primary. This winding should be tapped at the center. Seven turns of the same number wire are wound next to this and serve as the ionizing winding. A layer of empire cloth should be placed over these windings. The filament and ionizing windings should be held in place with tape. The two secondary coils consist of 620 turns of No. 20 D.C.C. wire and should be wound upon a form, taped and then slipped over the filament and ionizer windings. The completed transformer will measure 6"x¼" and will have two windows, each 2½" square as shown in the illustration. The two secondary windings of 620 turns each should be connected in series. All the high voltage secondary leads should be well insulated with varnished cambric tubing or with rubber. This transformer can be used in an A, B and C eliminator employing the new 400 milliampere rectifier and will deliver 4 volts at 5 amperes to the ionizer and 5.5 volts at one ampere for filament operation. It will also supply 360 volts at 300 milliamperes and 375 volts under no load conditions for the plates of the tubes.

Either double cotton covered wire, or single cotton covered enameled wire may be used. Except in the smaller sizes the use of plain enameled wire in transformers is not advisable. Enameled wire cannot be shellacked in place which is a distinct disadvantage. The number of layers of wire is found by dividing the total number of turns by the number of turns per layer. From this the depth of the winding may be calculated, allowing for any insulation between the layers. When the transformer is put under load, the core and windings may become warm. Although it is possible to design transformers to operate at low temperatures, a certain amount of heating is permissible, and transformers that run warmer can be built somewhat cheaper and more compact. The temperature rise, however, should not be so great as to damage the insulation. When the transformer is put under a full load the voltage across the secondary terminals will drop a small amount.

Scientific Humor

TO BURN OR NOT TO BURN

CHEMISTRY PROF: "What is the most non-inflammable liquid known?"

STUDENTS "The stuff they put in cigarette lighters."—*Sara Craig.*

COULDN'T BE THE EDITOR

It is said that by means of television, a face may be heard.

We often wondered what caused those awful noises we have heard on the radio, but now we begin to have a slight suspicion. —*David F. Kirby.*

REPEAT

"Supposing I were on strike, and lightning should blow the fuses at some building and I should be asked to do the refusing, what should I do?" asked the new electrician.

"Refuse," replied the old timer.—*K. F. Richards.*

SAWDUST

"Why do they speak of a man snoring as 'sawing wood'?"

"Because he has both 'pitch' and 'timbre!'" —*William Lemkin.*

ONE GOOD TURN

PROHIBITIONIST (sipping suspiciously): "I wonder what caused this cider to turn?"

OLD SOAK (maliciously): "Perhaps there was a worm in the apple."—*D. Himmelman.*

TOO MUCH MOON-SHINE

RUB: "I've named my car the 'Hen.'"

DUB: "Is that so? Chevrolet any eggs?" —*Clifton Ask.*

IDLE EYES

DOCTOR (looking at patient's eye): "I see indications of liver ailment and Bright's disease."

PATIENT: "Try again, doc. That's my glass eye!"—*Clifton Ask.*

FIRST PRIZE—$3.00

EAR—EAR

RIP: "Doesn't your wife enjoy the radio set you gave her for X-mas?"

SNORTER: "That's impossible old man. Its all listening, you know!"—*Henry A. Courtney.*

ACCEPTABLE—JUDGING BY WHAT WE HEAR

OPTIMIST: "G-g-good m-m-morning M-mister S-studio M-m-manager! — D-d-did you advert-t-tise f-for a g-g-good r-r-radio an-n-nouncer?"—*William Lemkin.*

ANOTHER NAME FOR IT

RADIO FANS BETTER HALF: "Oh Gerald, why don't you tune in some of those LOWER HARMONICS that this article mentions? I just love to hear good mouth-organ music on the radio!"—*William Lemkin.*

ALL jokes published here are paid for at a rate of $1.00 each; $3.00 is paid for the best joke submitted each month.

Jokes must have a scientific strain and should be original.

Write each joke on a separate sheet of paper and add your name and address to each.

Unavailable material cannot be returned.

LIE(K)LY AS NOT

"An affidavit is a long paper full of lies to prove you're not lying."

—*Robert Zarbock.*

LOVER OF NATURE

MRS. A: "What do you think of our radio?"

MRS. B: "Wonderful. Even your static is so much more powerful and distinct than ours."—*Rev. Wm. Stehle.*

FOR AIRPLANE USE . .

BOSS: "Since McSchnitzel opened that credit account here, he hasn't paid cash for a single thing."

CLERK: "Yeh, I'd call him a supercharger."—*Nelson Bitterman.*

SHINE 'EM UP

ELECTRICIAN TO HELPER: "Hey there, why didn't you clean this commutator?"

HELPER: "Why I didn't think it needed it with those brushes rubbing against it."

—*Ray Simmons, Rcp. No. 25,646.*

RUSHING TO FATE

INQUISITIVE PERSON: "Why is that man in the airplane sailing around over that big shed?"

OFFICER OF AVIATION (with a knowing smile): "He's in a hurry to land."

INQUISITIVE PERSON: "Why is he in a hurry to land?"

OFFICER OF AVIATION: "His moments are numbered, for he has a date with the hangar."—*Thaddeus E. Hedge.*

SHOULD BE DESTROYED

An Englishman, arriving home after an extensive tour in America, was asked about the road conditions there. He testifies as follows:

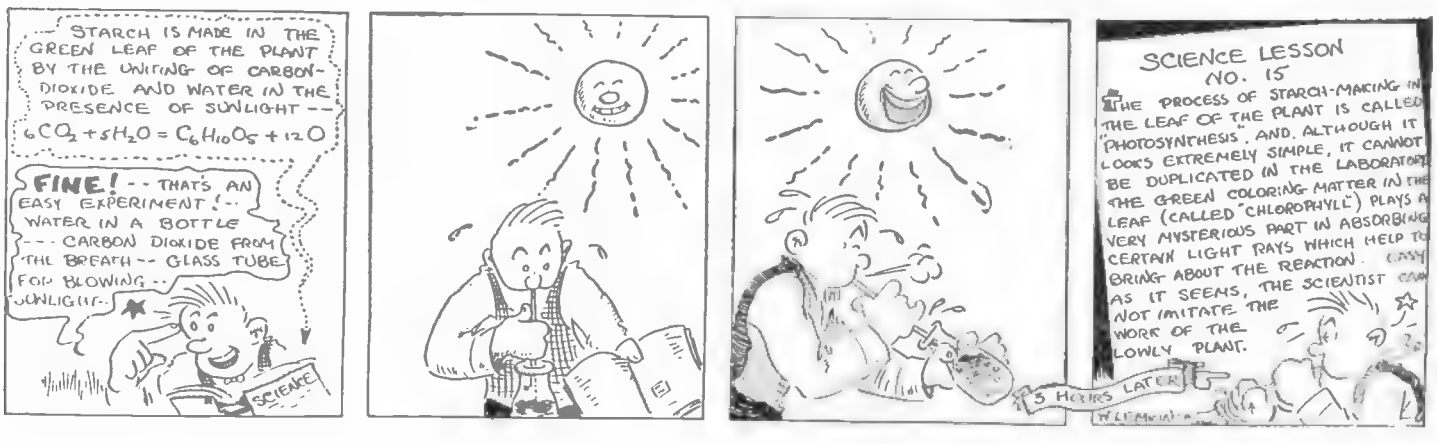
"Nearly all the roads in Hamerica are bally good, the Lincoln 'ighway, Washington Boulevard and Jefferson 'ighway, and all the roads built by the great Hamericans are excellent. But some bloomin' Frenchman by the name of DeTour built a lot of branch roads that are simply 'orrible, doncher know."—*John Lumyuk.*

CATALOGUE —WOODEN CAT

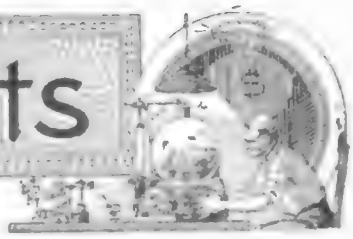
TEACHER OF SCIENCE: "Now, Johnny, you'll answer me this: What is an octopus?"

JOHNNY: "An eight-sided cat."—*Miss Helen Steach.*

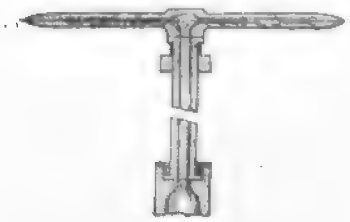
SCIENTY SIMON, Scientist


STARCH IS MADE IN THE GREEN LEAF OF THE PLANT BY THE UNITING OF CARBON-DIOXIDE AND WATER IN THE PRESENCE OF SUNLIGHT --
$6CO_2 + 5H_2O = C_6H_{10}O_5 + 12O$
FINE! -- THAT'S AN EASY EXPERIMENT! -- WATER IN A BOTTLE --- CARBON DIOXIDE FROM THE BREATH -- GLASS TUBE FOR BLOWING -- SUNLIGHT --
SCIENCE
SCIENCE LESSON NO. 15
THE PROCESS OF STARCH-MAKING IN THE LEAF OF THE PLANT IS CALLED "PHOTOSYNTHESIS", AND, ALTHOUGH IT LOOKS EXTREMELY SIMPLE, IT CANNOT BE DUPLICATED IN THE LABORATORY. THE GREEN COLORING MATTER IN THE LEAF (CALLED "CHLOROPHYLL") PLAYS A VERY MYSTERIOUS PART IN ABSORBING CERTAIN LIGHT RAYS WHICH HELP TO BRING ABOUT THE REACTION. EASY? AS IT SEEMS, THE SCIENTIST CAN NOT IMITATE THE WORK OF THE LOWLY PLANT.
5 HOURS LATER

Latest Patents

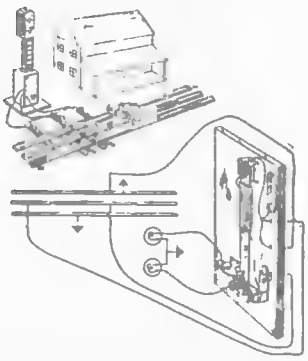


AERIAL PROPULSION



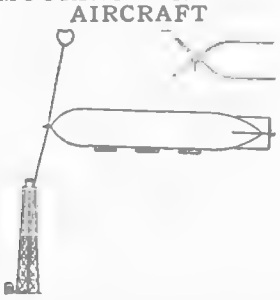
No. 1,637,389, issued to Peter Peterson. The invention shown above provides for the construction of an airplane propeller and means for operating same. The propeller comprises two separable plates, having a steam conduit to each blade. These conduits lead to the rear edges of the propeller blade and open into a large funnel discharge nozzle on the edge of the blade.

TOY ELECTRIC RAILWAY



No. 1,647,172, issued to Louis Caruso. The toy electric railway shown here has a power rail free from moving parts and an electrically operated thermostatic switch connected with the power rail circuit. Three fixed contacts are used, one connected to a current carrying bar, the other to an insulated section of the power rail. The third fixed contact is adapted to connect with a semaphore for indicating the position of the switch.

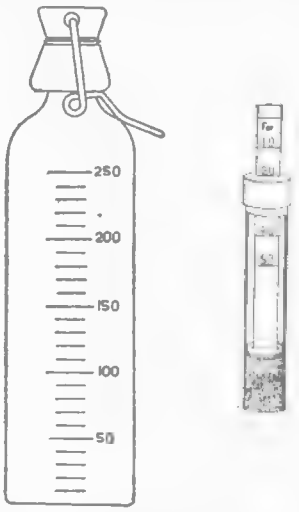
MOORING DIRIGIBLE AIRCRAFT



No. 1,634,964, issued to Joseph A. Steinmetz. The device shown above provides a method of mooring a dirigible balloon. The free end of an anchoring cable is lifted above ground fogs by a captive balloon. The captive balloon also carries identifying signals. The dirigible is clutched to the cable by the devices carried by the aircraft. A winch draws the dirigible downward until the drag lines reach the ground and the ship can thus be moved to its hanger.

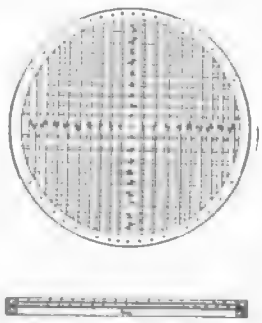
PREPARING LIQUID MILK

No. 1,637,415, issued to Karl Hefelmayr. This invention constitutes an apparatus for preparing liquid milk from milk powder. It comprises a mixing feeding bottle, upon the side of which a measuring scale has been marked.



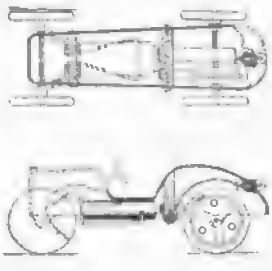
SHIELD FOR RADIOSCOPES

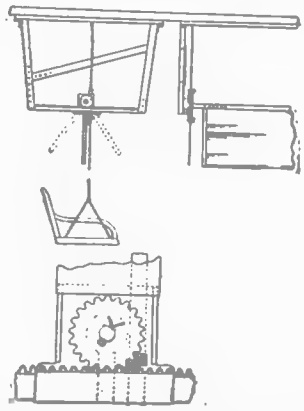
No. 1,638,683, issued to Mario Demarchi. The device shown below is a shield for the production of radioscopes or radiographs. It comprises a circular frame with a series of blades of X-ray opaque material.



ELECTRIC TOY

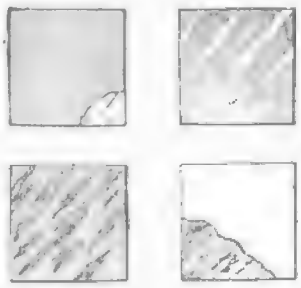
No. 1,637,479, issued to Harry C. Evelyn. The toy shown here has a switch arranged on the axle which intermittently closes a circuit leading to the headlights. A battery is carried within the body of the car providing current for the lamps.





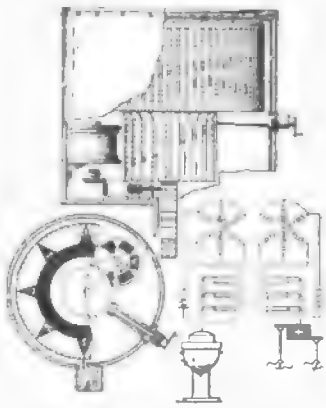
No. 1,638,379, issued to Fredrick R. Vordermark. The device shown above is a fan which is adapted to be used in conjunction with some moving object, such as a swing and the like. The fan is governed by the extent and rapidity of the movement of the swing.

PRODUCING IMITATION MARBLE



No. 1,623,967, issued to Joseph A. Moross. This process for producing imitation marble provides for the application of a second color while the first color is still wet, and tilting the support in various directions to effect a flowing of colors.

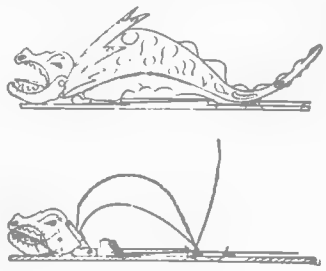
SIGNALING DEVICE



No. 1,638,417, issued to Elmer A. Sperry. The invention relates to a signaling means which can be employed upon aircraft advantageously. The device sends out a signal and also indicates the course taken.

FIGURE TOY

No. 1,649,072, issued to George Roy McAllaster. A toy of this class comprises a pair of supports, upon which is provided a means for gripping the surface over which the toy travels. Two anchoring portions are connected by a spring which causes the toy to advance along a suitable surface. A flexible connection causes the tail to move when the toy is advanced over a suitable surface.

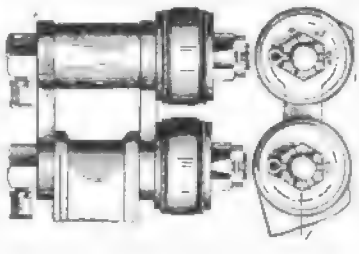


OPTICAL DISPLAY DEVICE

No. 1,582,199, issued to Frank P. Walters. This device comprises a number of imitation human eyes and a source of light adjacent to each eye. The object is to show the various differences between normal and abnormal conditions of the human eye. A means is provided for controlling the lights and a brain is provided with each eye which shows the optic nerves and the termination thereof.

SPRING-SHACKLING MECHANISM

No. 1,600,954, issued to Russell S. Begg. The spring-shackle shown below is an anti-rattling device and consists of two springs, one encircling the other. A further object is to provide spring-shackling between the spring and frame of a motor vehicle. A dust shield comprising a pair of sheet metal cap pieces has also been provided. The rear end of each spring is formed into a tubular section so that it may be provided with a suitable bushing.



NOTICE TO READERS: The above illustrated and described devices have recently been issued patent protection, but are not as yet, to our knowledge, available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information, as it is practically impossible to obtain up-to-date addresses. —EDITOR.

The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

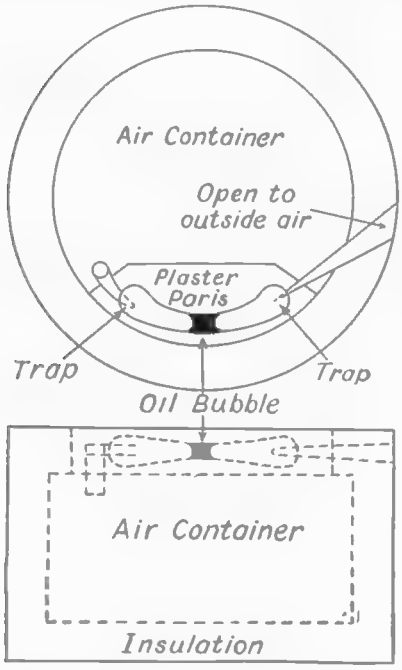
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculation, a special rate will be charged. Correspondens will be informed as to the fee before such questions are answered.

STATOSCOPE

(2230) J. C. Turner, Verdigre, Nebraska, asks:

Q. 1. Will you kindly publish a diagram showing the construction of an insulated bubble type statoscope and describe something of its working principles?

A. 1. You will find illustrated on this page a typical instrument of the type mentioned. It consists of an air chamber which is connected to the outside air by a curved glass tube, in which is placed a small, definite amount of liquid, usually a colored oil, to seal the air chamber. A scale indicates the relative position of the liquid. When the air pressure changes, owing to a change in altitude, the liquid moves up in the glass tube, forms a bubble and breaks in the trap provided for the purpose. During this time the air chamber pressure equalizes with that of the external air. The observation of the number of "breaks" gives a rough indication of the amount of change in altitude, and the observation of the rate at which the bubbles break gives an idea of the rate of climb or descent. The pressure changes for which the bubble breaks depend on the amount of liquid in the tube. A common value of pressure change for which the bubble breaks is .02 inches (.5 millimeter) of mercury, which corresponds to a change of altitude of 20 feet at sea level and 26 feet at 10,000 feet altitude. The movements of the liquid before forming a bubble serve to indicate much smaller pressure changes than .02 inch of mercury. This instrument must always be kept in a vertical position, both to prevent possible loss of liquid and in order to have the breaks occur at equal pressure intervals. Temperature changes in the air chamber which are caused by the equalization of its temperature with that of free air will cause the instrument to indicate falsely a rise or fall. False indications due to this cause are minimized by insulation of the air chamber.



Above are shown the details of the bubble type statoscope, which gives an indication to airplane pilots of the altitude and also the rate of climb.

DAYLIGHT BULBS

(2231) Wm. D. Illerich, Oakland, Calif., asks:

Q. 1. Are there any bulbs on the market at the present time which will produce a light directly comparable to daylight or sunlight?

A. 1. In producing artificial sunlight, it must be remembered that all of the daylight is not the same. Daylight coming through a north window contains about one and one-half times as much blue light as daylight coming directly from the sun at the same instant; and contains but three-fourths as much red light. Some gas-filled daylight lamps produce a light which exactly matches the visible portion of daylight. However, they do not as a rule generate the correct proportions of infra-red and ultra-violet necessary to reproduce all the characteristics of sunlight. These lamps are generally used as a substitute for daylight, in matching colors.

MOTOR DESIGN

(2232) H. A. Brankstone, Pittsburgh, Pa., asks:

Q. 1. Can you give me the data for building a one-eighth horse-power motor, similar in construction to the one-sixteenth horse-power motor described in "How to Make It?"

A. 1. We regret that we do not have any data on any other motors of this particular type, excepting the 1/16 H. P. size, the details for which appear in the article you mention. You could, of course, do a little experimenting and build a motor of larger size on the same principle as the 1/16 H. P. design given in "How to Make It." For a ⅛ H. P. motor you would need a larger rotor, and you could, for example, have the rotor of the same diameter with the same number of copper inductor bars, but make the length of the rotor twice the length of that given for the 1/16 H. P. design. You will have to experiment with the stator coils, so that the motor will draw the proper amount of current so as not to overheat, and at the same time to sufficiently magnetize the stator frame or core, so that the rotor develops approximately ⅛ H. P.

COLD AIR INLET

(2233) T. Shade, Dayton, Ohio, writes:

Q. 1. We have a hot air furnace which has seven pipes leading to as many rooms. The cold air intake comes from the outdoors and is a ten-inch pipe. We wish to take the cold air from the hall through a floor register. What size would you suggest to supply ample circulation? At present this plant is not satisfactory.

A. 1. The efficiency of a warm air furnace depends upon the completeness of the air circulation. In revising your present furnace installation, we would suggest that you use at least a 20-inch pipe for the cold air duct. Its cross section area should be at least as much as the total area of the other pipes leading to the rooms. Probably the reason that your present installation is not working well is that the 10-inch cold air intake is inadequate. In locating the cold air register put it in the hall of the house or in some place where it will draw air from a number of rooms rather than from a single one. In many cases, it is desirable to have two cold air inlets to the furnace casing to improve the circulation. If you install two, each one should be about 16 inches in diameter.

SINGING WIRES

(2234) M. Landrey, Brooklyn, New York, asks:

Q. 1. Can you give me some information as to the cause of singing telephone wires? I have noticed sometimes when the wind is blowing hard the wires are silent and in calm weather they sometimes emit a singing sound.

A. 1. Those who live in the vicinity of telephone and telegraph poles are familiar with singing wires. Sometimes when the wind is blowing hard, the wires are silent, whereas in time of calm they are sonorous. Evidently the vibration of the wires is not due to atmosphereic agitation alone. Recently a Paris scientist investigated the cause of the singing of wires and concluded that the vibration of the wires always presages the approach of bad weather. When the sounds are deep, he said, the change of weather may be looked for within two days; when they are shrill or sharp, that is, of high pitch, the storm will arrive within a few hours. It is difficult to determine the real cause of the singing. An American scientist calls it seismic agitation produced by barometric depression and transmitted to the wires by the telephone and telegraph poles.

IMITATION MEERSCHAUM

(2235) J. D. Marti, Easton, Pa., asks:

Q. 1. Will you describe briefly a simple method for making imitation meerschaum?

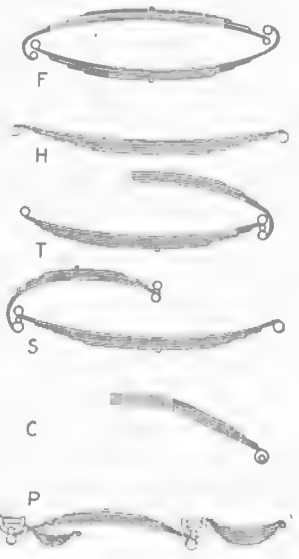
A. 1. Macerate common peeled potatoes for thirty-six hours in water to which has been added 8 per cent sulphuric acid. Dry on blotting paper, and for several days on plates of plaster of Paris in hot sand. While drying, the potatoes should be subjected to great pressure. This may be done by means of weights. When finished it can be carved like the genuine article.

FORMS OF LEAF SPRINGS

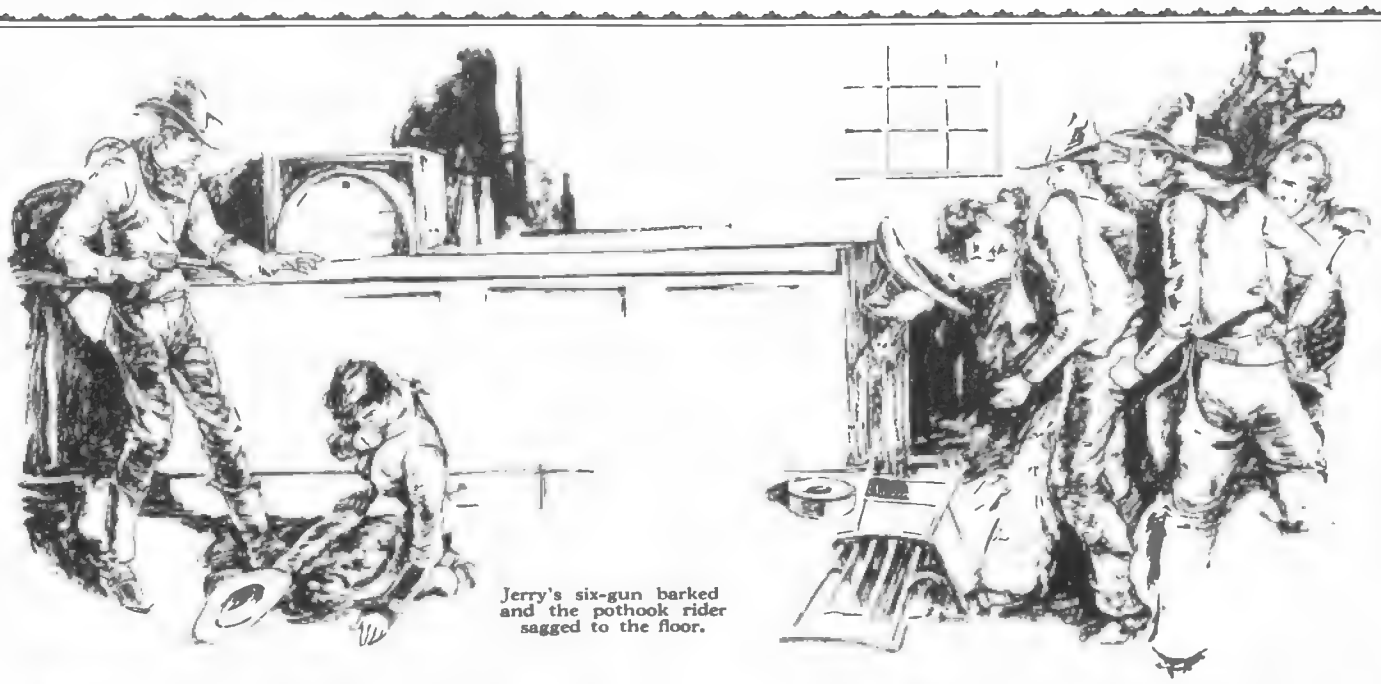
(2236) A. E. Stoker, Union City, N. J., writes:

Q. 1. Will you please illustrate the various forms of leaf springs which are used in modern motor car construction?

A. 1. On this page you will find illustrated several forms of the most common type of leaf springs used. The springs used for supporting the frame of the car on the axles are almost always made from long, flat leaves and are therefore called leaf springs. These springs are divided into several classes, according to the shape of the spring or the parts of it. All classes are denoted by the part of an ellipse which they form. A spring made of two parts placed one over the other and hinged at the ends, so that the whole is oval-shaped, is called a full elliptic spring and is shown at F in the drawing. The center of one spring rests upon the axle—the body of the vehicle rests upon the center of the other spring. A spring in one piece like one-half of the full elliptic is called a half-elliptic or semi-elliptic, shown at H. The axle is under the center of the spring and the body rests at both ends. A spring formed of a semi-elliptic part, with half of another semi-elliptic above it is called a three-quarter elliptic spring, illustrated at T. The axle is mounted near the center of the half-elliptic lower part, the end of the upper quarter-elliptic is hinged to the rear end of the lower part, the front of the lower part fastens to the body and the other end of the upper quarter fastens also to the same. If the upper part of a three-quarter elliptic spring is longer than one-quarter of the oval, the spring is called a seven-eighth elliptic, shown by S in the diagram. Springs formed of half of a semi-elliptic are called quarter-elliptic springs, and are illustrated at C. They carry the axle at the thin end and are mounted on the frame at the other end. A spring that is between a half and a quarter-elliptic in length is called a cantilever spring. It carries the axle at the small or thin end and is fastened to the frame at two points near the other end. Front springs are usually semi-elliptic, full or three-quarter elliptic. Rear springs are usually three-quarter elliptic, semi-elliptic, full elliptic, seven-eighth elliptic, cantilever, or quarter elliptic, this being the order in which they rank as to the number used. Coil springs are sometimes used to assist the leaf springs. Auxiliary springs are springs mounted in such a way that a heavy load brings the frame near enough to the axles, so that the auxiliary springs touch the axle or frame and come into action.



The various forms of leaf springs which are used in modern motor car construction are shown in the illustration at the right. All classes of springs are denoted by the part of an ellipse which they form, thus, a spring made of two parts, placed one over the other, and hinged at the ends so that the whole is oval-shape, is called a full elliptic spring, and is shown at F in the drawing. Since these springs are made from long, flat leaves, they are called leaf springs.



Jerry's six-gun barked and the pothook rider sagged to the floor.

Bonanza Backs the Law

[a Jerry Balsam Story by Richard A. Martinsen]

JERRY BALSAM, one-time famous outlaw, had laid aside his six-guns to live the life of a peaceful rancher of Coyote Country. But he strapped them on again when he learned that a mining syndicate was out to get him and get him quick! What happened afterward in Paradise, the little cowtown, is told in hair-raising fashion in this splendid western story, and as only Richard Martinsen, the author, can tell it. "Bonanza Backs the Law" appears in the February number of "Triple-X," the popular magazine of western fiction. Now on sale!

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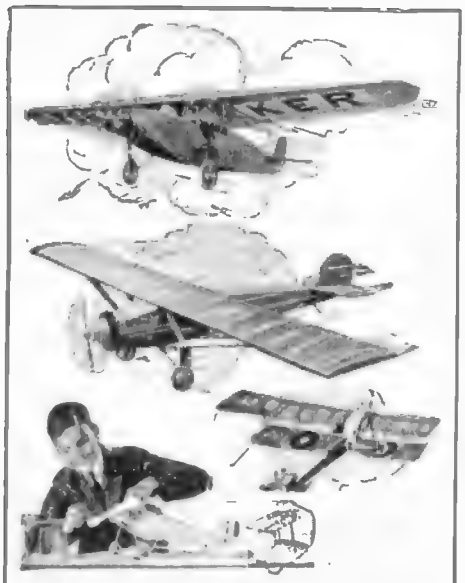

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MOTOR HINTS

(*Continued from page 903*)

amperage than this is indicated, the owner should look for trouble in the wires.

The magnetic type of vibrating horn is much like a Ford spark coil. The contact points should be occasionally filed off and the diaphragm adjusted to compensate for the amount removed by filing. To file the contacts, the rear cover of the horn should be removed, while to adjust the diaphragm, a screw driver is used through the projector of the horn, turning a screw on the front of the diaphragm.

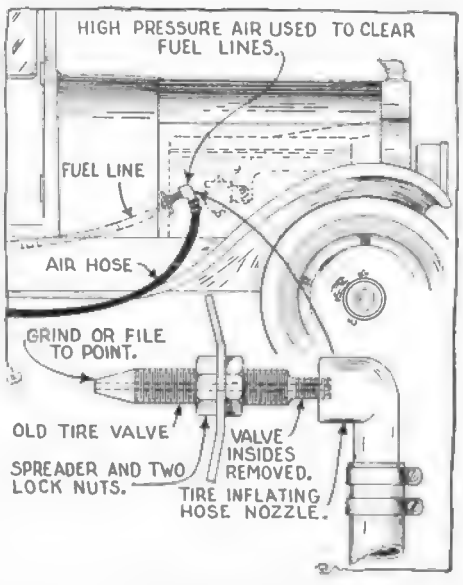
The motor driven horn should be lubricated each three months, and any surplus oil, especially around the commutator should be wiped off. The vibrator type of horn needs no oil, but this type should be kept clean and the connecting wires should be tight on the terminals at all times, especially the terminal post connecting to the wire from the horn button.

HIGH-PRESSURE AIR FOR CLEANING FUEL LINES

The most serviceable and simple means for clearing fuel lines of muck and other accumulations, is by means of a high-pressure stream of air. It is usual in the shop to have a high-pressure line fitted with a small nozzle and a valve for turning the air on.

An ordinary hose connection for tire pumping, is not suitable for cleaning pipe lines, as it is impractical to hold the valve open by the same means as is done while pumping tires.

An ingenious expedient used by one motorist, is the means shown in the attached sketch. In this scheme the stem from an old valve is used, with a base spreader and two nuts, forming a finger hold. The valve is pointed, so to enter the end of a pipe


HIGH PRESSURE AIR USED TO CLEAR FUEL LINES.
FUEL LINE
AIR HOSE
GRIND OR FILE TO POINT.
OLD TIRE VALVE
SPREADER AND TWO LOCK NUTS.
VALVE INSIDES REMOVED.
TIRE INFLATING HOSE NOZZLE.

How to use high-pressure air to clear fuel lines.

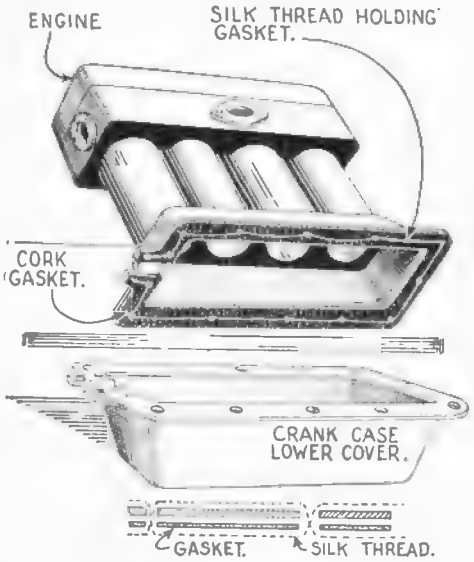
or other small opening. By means of this the tire hose connection can be opened and the air from this line used as frequently as desired.

"MAYDAY" SELECTED AS S O S CALL

A distress call for use in radio-telephony and to be the exact equivalent of the universal S O S in radio telegraphy has been devised by the International Radio Conference and has been incorporated in the new international wireless convention.

HOLDING CORK GASKETS WHEN INSTALLING COVERS

Cork gaskets, such as are invariably used under valve covers, crankcase cover, rear axle, housing cover and transmission covers, will only hold without leakage when they do not have breaks in them.



How to make cork gaskets remain in place while replacing crank case.

These gaskets are flimsy and are frequently dropped out of place when bolting the cover or so misplaced that the bolt punches through a section of the gasket and opens up a leaky place.

One of the best means for installing a cork gasket, with assurance that it will be in place, is with the use of a silk thread to tie it up and fix it in position.

The sketch illustrates this method, showing the gasket ready for the cover. The silk thread can be run through bolt holes and also will remain on the gasket, without interfering with screwing in the bolts. If the crankcase persists in leaking through the gasket, put it on by this means and the leak will invariably be stopped.

The new call for help is "Mayday," to be spoken through the broadcasting apparatus. This would be followed immediately, as in the case of an S O S, by details as to the location of the origin of the call.

"Mayday" is the phonetic spelling of the French words "M'Aider," meaning "help me."

BRITISH LOCOMOTIVE USES OIL AND STEAM

A locomotive which is said to establish a record for a combination of revolutionary features in a single design has just been completed at Leeds and is known as the Kitson-Still internal combustion locomotive.

The engine combines internal combustion with the expansive force of steam. The power unit, which is the result of ten years' experimenting, consists of eight double-action cylinders using both steam and oil vapor, the steam entering the cylinder at one end and the atomized oil at the other, or on the down stroke, so that it acts alternately as a steam and internal combustion engine.

The oil is not only employed for internal combustion, but is used in raising steam. These are only two of several unusual features.

It is asserted that the fuel cost of the new engine will be half that of the ordinary type.

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Lugs, nuts, jacks, plugs, all kinds of knobs, cords, panels, screws, sliders, washers, selenium, tinfoil, switches, crystals, cap nuts, Litz wire, cord tips, brass rods, resistances, binding posts, switch parts, carbon balls, switch points, lock washers, carbon grains, ground clamps, metal pointers, insulated tubing, low melting metal, antenna connectors, as well as thousands of other articles. *We carry the Largest Variety of Small Radio Parts in the World, BUT We also carry All Standard Radio Merchandise.*

ANYTHING IN RADIO

Radio Specialty Co

98 PARK PLACE NEW YORK

6 WEEKS AGO he clipped the coupon

Other fellows had left him in the social background. Girls avoided him. He was missing all the modern fun. Then, one day, he read an advertisement. It held out a promise of popularity if he would only learn to play a

BUESCHER
True Tone Saxophone

He thought himself musically dumb. Still, the ad said it was easy. He mailed a coupon, and later sent for a Saxophone for 6 days' trial. Before the end of the week he was playing easy tunes. That was 6 weeks ago, and today he's "popularity" itself. Always welcome everywhere.

You Can Teach Yourself

If you can whistle a tune, if you can beat time, you can learn to play the Buescher Saxophone, Easily! You can teach yourself, at home, in a few evenings. Three simple lessons given on request with each new Saxophone start you. You learn scales in an hour and start playing tunes in a week. Your progress will astonish and delight you and surprise your friends.

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Take home with you any Buescher instrument, Trombone, Cornet, Trumpet, Saxophone for six days' trial. Test it. See what you can do with it. If you like it, pay a little each month. Play as you Pay. Satisfaction guaranteed. Send for beautiful free catalog of any instrument and details of trial and payment plans. No obligation. Do this today.

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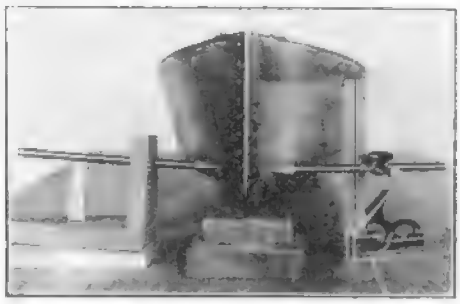
Hints for the Mechanic

WATER-LINE MARKER

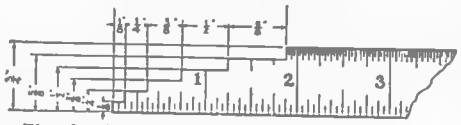
FIRST PRIZE—$10.00



The above photograph shows how to use the scribers for marking the water-line on a model boat.

In order to accurately mark the water-line of a model boat, construct either one of the two scribers shown. The scriber is placed on one side of the hull. One scriber is made by clamping a pencil to a combination square, the other from a block of wood, a wedge, and a pencil, as shown in the photo.—*D. P. Watson.*

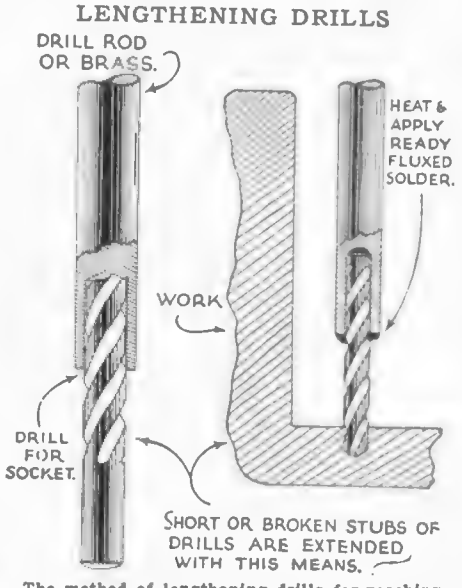
IMPROVED RULE



The details of the improved ruler are shown above.

A quick measuring rule may be made by cutting a number of steps in the ruler as shown above. The rule may be used for measuring small distances, either along its length or its width, and the size can be quickly and accurately determined. A metal rule should be used, as it will not become broken or chipped.—*Contributor send name and address.*

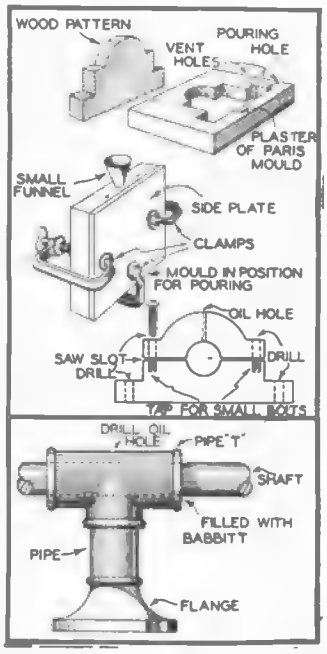
LENGTHENING DRILLS


DRILL ROD OR BRASS.
HEAT & APPLY READY FLUXED SOLDER.
WORK
DRILL FOR SOCKET.
SHORT OR BROKEN STUBS OF DRILLS ARE EXTENDED WITH THIS MEANS.

The method of lengthening drills for reaching into deep positions is shown above.

To lengthen a drill, proceed as follows: drill a hole into one end of a piece of drill rod or brass rod. Then, sweat the end of the drill into the hole, by holding in a flame and touching with self-fluxing solder. Broken drills may also be repaired by using the above method.—*G. A. Luers.*

HOME-MADE BEARINGS



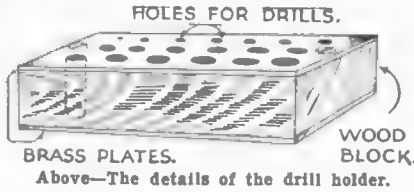
Bearings for light work may be easily made as shown in the sketch at the right. A pattern is first made of wood and a mould poured from this pattern. Vent holes and a pouring hole are arranged. The bearings are cast from babbitt metal in one solid piece. A hole is drilled in the center for the shaft and the bearing is divided with a hack saw. An oil hole is drilled as shown and the top section is bolted to the body part. Hangers may be made as shown from pipe fittings. The pipe T, through which the shaft passes, is filled with babbitt to form the bearing.—*E. H. Fisel.*

A New Department

MECHANICS' needs have caused us to start this new department—"Hints for the Mechanic," in which we intend to publish wrinkles useful to mechanics in general. You can help us with this department by writing a brief description of your favorite shop wrinkle and sending this to the editor of this department, together with a pencil or pen and ink sketch of the wrinkle. The ideas published herewith will give you some idea of what we want. Our draughtsmen will make the necessary mechanical drawings, so you need not send us finished drawings. We will pay $10.00 each month for the best Wrinkle or Hint sent in; others published will be paid for at space rates. Address all letters to Editor, Hints for the Mechanic Department, in care of this magazine.

DRILL HOLDER

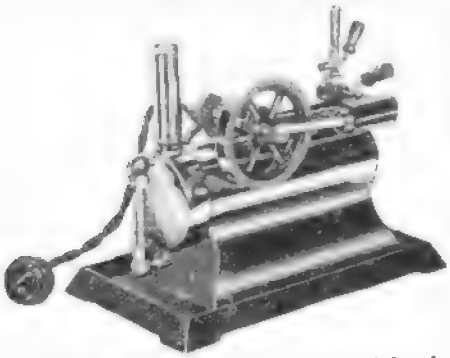
A handy drill holder can be made from a piece of wood about 6 inches long. Brass plates are fastened on either side of the



Above—The details of the drill holder.

wooden block. Holes are now drilled through one brass plate, through the wood, to the other brass piece. Do not drill through the second brass plate.—*C. F. Felstead.*

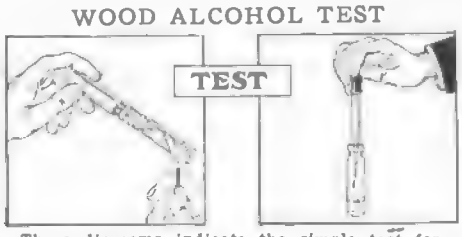
ELECTRIC STEAM ENGINE



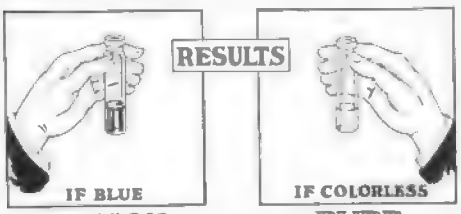
The photograph above shows a new style of ciectric steam engine. It consists of a boiler and single-acting horizontal type engine, a whistle and steam shut-off valve. The mechanism is heated by a 300-watt coil in juxtaposition with and under the boiler, hidden by the base.

—Illustration Courtesy Metal Ware Corporation.

WOOD ALCOHOL TEST



These diagrams indicate the simple test for wood alcohol. The one at the left shows a simplified still, made of two bottles and a perforated cork. The test is made on the distillate in the manner indicated at the right.

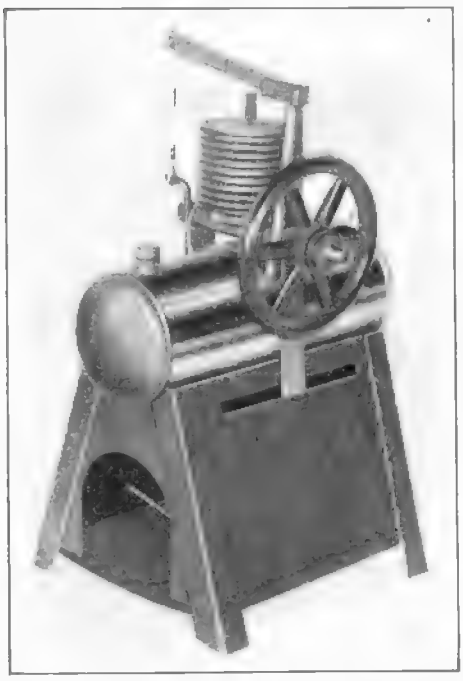


POISON **PURE**

If, after adding the reagents in order, the distillate remains colorless 20 minutes later, any liquid from which the distillate has been obtained can be considered free of acetaldehyde, wood alcohol, formaldehyde, etc.

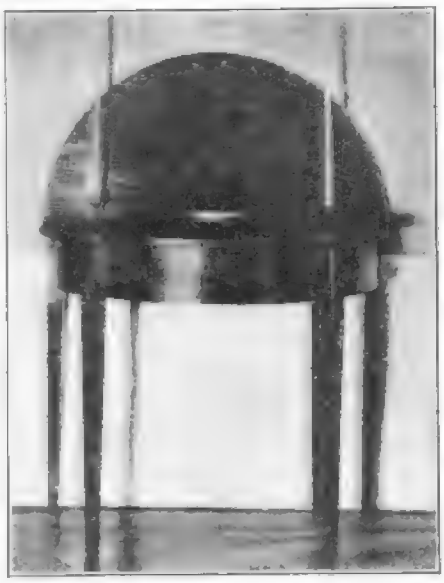
—Illustrations Courtesy Detectol Mfg. Co.

PUFFER ENGINE

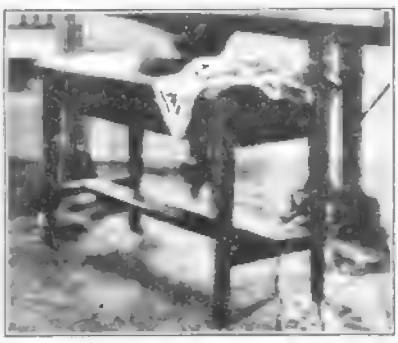


A very unique engine is indicated above. The accordion-pleated metal cylinder on top serves as the piston. This vibrates back and forth very rapidly. The cylinder is made of metal.

—Photo Courtesy The Fulton Co.



CARD or CONSOLE TABLE
See LePage's Book, page 17



PIANO BENCH
See LePage's Book, page 9

PRISCILLA SEWING BOX
See LePage's Book, page 11

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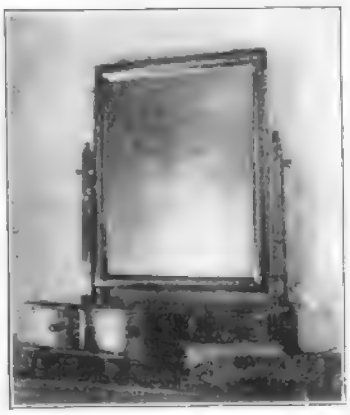

DRESSING GLASS
See LePage's Book, page 21

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In addition to the four pieces illustrated above, the book includes the following 16 projects: Occasional Table, Spanish Ship Model, Folding Sewing Screen, Fernery Stand, Tilt Top Table, Piano Bench, Costumer, Priscilla Sewing Box, Table Desk, Desk Chair, Card or Console Table, Turned Bench, End Table with Book Trough, Foot Stool, Book Stand and Back Rest. Where else could you get complete directions for making all these things for only 10 cents?

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Forty—The Danger Age

These are the facts, just as I learned them. In 65% of all men, the vital prostate gland slows up soon after 40. No pain is experienced, but as this distressing condition continues, sciatica, backache, severe bladder weakness, constipation, etc., often develop.

Prostate Trouble

These are frequently the signs of prostate trouble. Now thousands suffer these handicaps needlessly! For a prominent American Scientist after seven years of research, discovered a new, safe way to stimulate the prostate gland to normal health and activity in many cases. This new hygiene is worthy to be called a notable achievement of the age.

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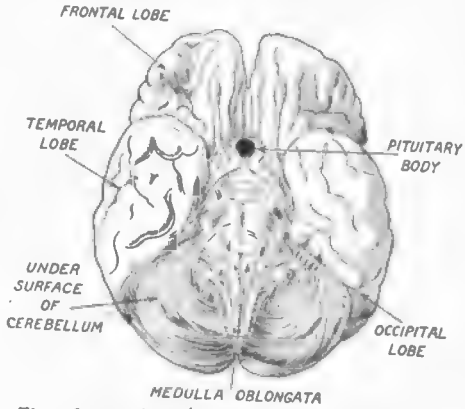
GLANDS MAKE GIANTS, NOT PRIZEFIGHTERS

By FREDERIC DAMRAU, M.D.

(*Continued from page* 899)

gland lying within must be extremely oversized and overactive.

There is no appeal from the mandate of the pituitary gland. When it commands the bones to grow, they must necessarily expand their dimensions according to the will of their diminutive but all-powerful master. But one important distinction depends on



The above diagram shows the base of the brain and indicates in particular the position of the pituitary body. It is this tiny gland whose over-activity can cause freak or abnormal conditions in our body.

whether the pituitary gland asserts itself before or after maturity.

Until about the age of eighteen, the bones are still capable of lengthening; consequently, one may grow taller. After that time, more or less, the length of the bones has been definitely fixed and nothing can increase the individual's height.

If the pituitary boss is restless and works overtime in a person under eighteen, his bones will be stimulated to grow beyond the normal length. The result will be an individual of supernormal stature; that is, a giant.

On the other hand, if the tyrant within the skull does not become domineering until after the age of maturity, the long bones receive the command to enlarge at a time when their shafts are hardened and cannot therefore become longer; but they show the effects of stimulation in other ways. Bony enlargements appear on various parts of the skeleton, especially on the sharp points. The whole face becomes enlarged and coarse in its bony contour. The lower jaw is protruded, the front teeth are spaced, the eyebrows jagged and overhanging, and the cheek bones sharply conspicuous. At the same time, the hands and feet enlarge so rapidly that the individual must increase the size of his shoes and gloves every few months.

This condition is known as *acromegaly*. It is the same matter of an over-ambitious pituitary gland, the only difference being in the onset of the trouble later in life.

Frequently the two conditions of giantism and acromegaly go hand in hand. As a matter of fact, most pituitary giants have distinctly acromegalic features; that is, their lower jaws are prominent, their teeth spaced, and their features large and bony.

PITUITARY GLAND DOES NOT MAKE FISTIC CHAMPIONS

It has been suggested that the supermen of the fistic ring owe their supremacy to the fact that overactivity of the pituitary gland has placed a touch of the giant in their make-up. With this view I cannot agree in the least.

In the first place, pituitary giants are noted for their weakness, not their strength. It is true that they may temporarily be capable of feats of great physical prowess. But whatever superiority they may possess in this respect is short-lived and soon gives place to muscular inferiority.

The history of our greatest fighters does not show that they held the world's crown for a few years, only to become invalids thereafter. It is true that, a few decades back, some virtually drank themselves into the grave; but most fighters, who have taken proper care of themselves, have enjoyed good health for many years.

We may take Jack Dempsey as an example. The Dempsey who came within an ace of defeating Gene Tunney at Chicago on September 22, 1927, was probably little short of the Dempsey who knocked Willard out in the third round at Toledo on July 4, 1919. Dempsey still shows an amazing punch, is still a likely candidate for the world's championship, and—I venture to state—will not occupy an invalid's chair for many years to come.

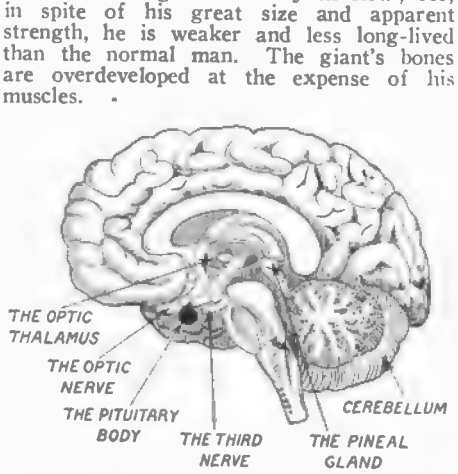
J. J. Corbett continued to give boxing exhibitions for many years after his retirement from the ring, and he displayed not only amazing skill, but also retained his strength and vitality. Certainly I can see no comparison between the sustained vitality of the boxer and the short-lived burst of strength shown by the pituitary giant.

I recall mistaking Carpentier for a tennis player. He spoke to a friend of mine while we were watching Borotra play, and I was not aware of his identity until I heard his name. This incident brings out the point that there is nothing out of the way—physicians say abnormal—about pugilitsts when they are dressed in their street clothes. They do not look at all like prize fighters, except for the powerful development of their shoulders.

Pituitary giants, on the other hand, have striking features. Their faces are usually of the acromegalic type, as has already been described. But, if we study the features of Gene Tunney or Jack Dempsey, we can see none of these abnormal traits. They could just as well pass as movie heroes.

There are tens of thousands of men in the overactive pituitary class, but apparently only two in the Tunney-Dempsey class. It takes more than the pituitary gland to make a Tunney or a Dempsey. It requires a perfect physique, unusual muscular development and lightning reflexes to start with. But, in addition, the pugilistic champion must possess supreme courage, rapid judgment, and the perseverance to stick to training in the face of all temptations.

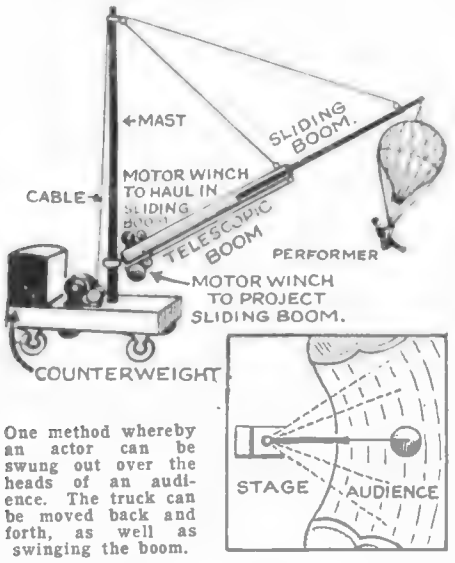
We recall that Jack, in the fable of *Jack and the Bean Stalk*, killed the giant by cutting the bean stalk and allowing him to fall. And the abnormal pituitary giant is very much like the giant whom Jack slew; for, in spite of his great size and apparent strength, he is weaker and less long-lived than the normal man. The giant's bones are overdeveloped at the expense of his muscles.



A vertical median section of the brain, showing also the location of the pituitary body.

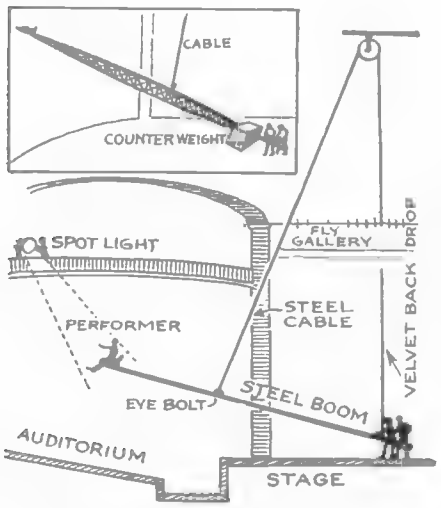
The Flying Piano

(Continued from page 803)



One method whereby an actor can be swung out over the heads of an audience. The truck can be moved back and forth, as well as swinging the boom.

one end of the boom as shown. One method of supporting a girl and a balloon which was used on a New York stage, is also explained here. In this case, the balloon and the girl were fastened to the end of a sliding tubular steel boom. A motor winch was used to telescope or extend the boom at will. Both the telescopic and sliding booms were supported by cables and could be moved in various directions, as shown. The whole arrangement was placed upon a movable truck with a counterweight situated at the rear end.



By using either a center-supported steel boom or a counter-weighted boom, a performer can safely and easily be swung out over the audience.

U. S. Navy Flier Wins Altitude Record

Lieutenant Carlton C. Champion, the plucky navy flier who refused to leave his "ship" after it had developed engine trouble and burst into flames, has been credited with having attained the greatest altitude ever reached by man in a heavier-than-air machine.

A communication received December 9th by the National Aeronautic Association from the Federation Aeronautique Internationale, announced that the latter organization, the recognized arbiter of aerial records, had accepted Champion's mark as a record.

The barograph, which Lieutenant Champion risked his life to preserve in the perilous descent, showed after calibration that his plane, a Wright Apache, had reached an altitude of 38,474 feet on a flight last July 25th from Anacostia naval air station.

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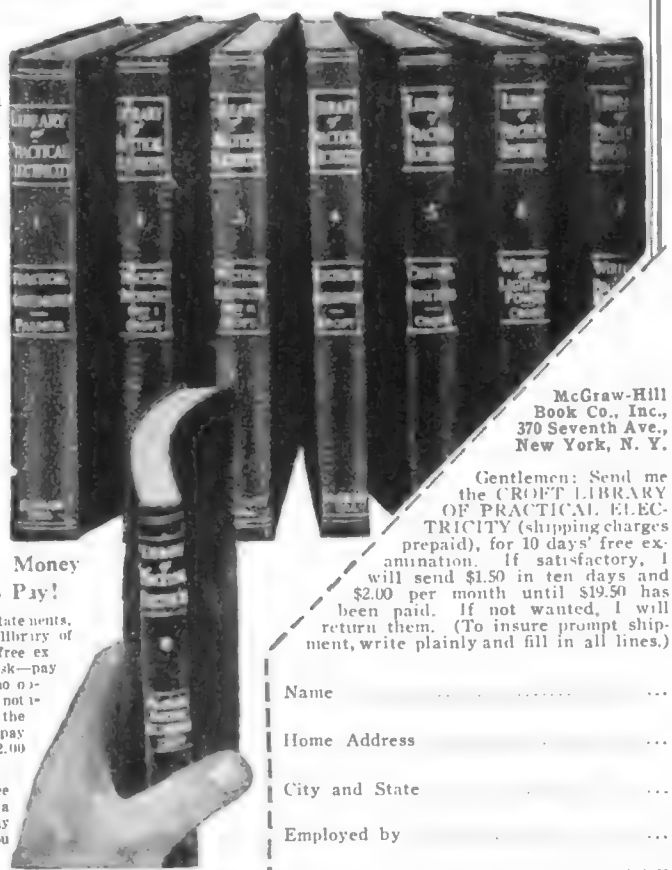

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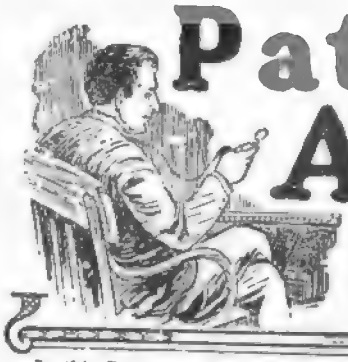

Patent Advice

Edited by
Joseph H. Kraus

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain patent phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail, a nominal charge of $1.00 is made for each question. Sketches, and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

DRUM-HEAD LOUD SPEAKER

(1067) James J. Woodside, New York City, submits a suggestion for a drum-head loud speaker which consists of coupling a telephone receiver to a drum-head-like diaphragm. He requests our opinion of the same.

A. 1. Many years ago the editors of RADIO NEWS and SCIENCE AND INVENTION Magazines tried various materials in the construction of the diaphragm of a loud speaker. A banjo, a snare drum, a bass drum and various other articles were used, including the wooden shell of a violin. While they all produced results, their results were far from satisfactory, because they did not cover the necessary range which a loud speaker should be made to cover. Their natural periods of vibration are entirely too pronounced and these periods have a resultant effect upon the ultimate sound or voice signal. We would most assuredly advise you to stay away from any attempts at patenting this suggestion.

PERPETUAL MOTION AGAIN!

(1068) K. Stewart Hood, Pittsburgh, Pa., submits a suggestion for a motor-generator set, the generator being connected with a storage battery and the motor being operated by the storage battery. He does not call it perpetual motion, saying that the efficiency of the generator is below that of the motor, but he wonders how much power the system might save.

A. 1. We do not see how a motor-generator hooked up as indicated by you could possibly save any power. It is quite obvious that as power is being generated by the motor, more power must be consumed by the motor in turning over the generator. Consequently, the constant losses in the transference of the current into power and the power into current again will always be present. You can gain nothing at all in the arrangement proposed.

PHONOGRAPH RECORD TURN-OVER

(1069) Fred Pearlman, Asheville, N. C., asks whether it is possible for him to secure a patent because he is under the age of sixteen. He also advises that he has a system which enables a record to be played on both sides before discarding it and it can be used on the new repeating types of phonographs.

A. 1. Yes; any attorney will assist you in obtaining a patent and you will find no difficulty in securing one, even though you are under age.

Appertaining to your device for the turning of records before they are discarded, we would suggest that you have a patent search made to demonstrate whether or not there are other similar systems already covered by patents. If memory does not fail us, we have seen several such methods in past issues of the Official Patent Gazette which may be different than the system outlined by you and perhaps even better than your method. We would advise that you have a search made, after having made the necessary sketches.

RADIO STATION INDICATOR

(1070) Arnold Lesti, Los Angeles, Calif., asks whether we think it would be a good idea to patent a radio station indicator which, by means of lights, would indicate which broadcasting stations were on the air and which were off. He claims that this can be made as an attachment for radio receivers at a cost not exceeding $5.00. He further states that several manufacturers are interested in his invention, and also one party who is going to help him in the sales for a 15% royalty.

A. 1. We certainly do. We think it is an excellent idea to patent this suggestion and advise a patent search and further action, on condition that the apparatus will do what is claimed for it. An idea of this nature should meet with a very good market and if properly constructed and easily applied, there should be no difficulty in disposing of hundreds of thousands of these devices.

Why go to the trouble of giving an organization 15% of the sales price, should they sell your invention, if you already have six concerns on hand that are ready to take an active interest in your method? There is no reason why you should not cash in on that royalty, instead of giving it to someone else. You can better arrange terms yourself. Your own attorney, (for a comparatively small sum) will draw up the necessary contracts and you will be satisfied that you have done business with the original parties, without any intermediary and at the same time received full value for your invention.

Of course, we still doubt the possibility of any invention doing this work, unless the invention itself is rather costly. We do not see how a station, when it is off the air, can extinguish a light on the dial and the instant that station goes on the air, the dial will light up. It is obvious that this will require a great number of miniature bulbs or miniature signals in the form of semaphores or shutters and that these signals will have to be operated or actuated by a radio set, properly amplified, and previously tuned to the respective transmitting stations.

AUTO LOCK AND MIRROR

(1071) F. D. Carpenter, Concord, N. H., sends in two plans, one of which consists of an automobile lock, so arranged that it will prevent the rear wheels from turning in any except a backward direction, and the other is a mirror holder. He asks our opinion of both.

A. 1. Frankly, we do not think that the automobile lock which you have designed is a very good proposition, nor do we believe that you can get any extensive sale for the same. While you have seemingly gotten around most of the fire department regulations which prevent an automobile from being locked so that it cannot be moved, you have not prevented the theft of the auto. It is a very simple matter for a wrecking crew to back up against the car, lift up the rear wheels and tow the machine away. This method is resorted to more frequently than one would at first suspect. Likewise if the car is placed in a garage in such a position that it is up against the rear wall, it becomes absolutely impossible to move the automobile, unless someone can manage to cause the rear wheels to rotate, raising the lock to its top position, and then insert a plug here to hold it fixed, away from the notches into which it is to engage. We believe that the mechanism entails too great a difficulty in applying the same and too much trouble in locking and unlocking.

Our opinion concerning the mirror is contrary to the one mentioned above. You have designed quite a unique mirror holder which, if placed on the market, should meet with quite good success. A resilient mirror holder which will always carry the mirror back again to the correct position but which is rigid enough to prevent minor vibrations from affecting it, and constructed as cheaply as you have illustrated, is quite to be desired.

We wish you the best of success in your venture.

(*Continued on page* 936)

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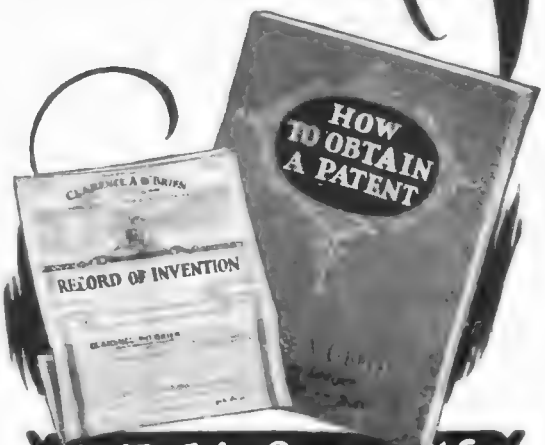

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Patent Advice

(*Continued from page* 934)

LATEST PATENTS?

(1072) William Michel, Oak Park, Ill., has submitted to us a copy of a patent on a sewer and well casing and he asks whether it is worthy of listing amongst our Latest Patents.

A. I. Unfortunately, our Latest Patents are invariably very late issues and a patent two years old cannot find a place on these pages. The editors of this publication look through the Patent Gazettes each week and order those patents which they think are different and which appeal to many of the readers interested in SCIENCE AND INVENTION Magazine. While we do not doubt but that the idea presents some valuable features, it is quite evident that the construction has not met with a very great appeal by casing builders. Had the inventor requested our opinion before proceeding with the patent on the suggestion, we would have cautioned him.

NEON LAMPS AND TOY

(1073) Henry C. Rolphe, Portland, Ore., asks whether a patent can be obtained for different uses of the Neon tube, such as for traffic signals, railroad semaphores, etc. He also would like to know whether we think there is a possible chance of placing the toy on the market in the form of a roller-coaster.

A. 1. The use of an article for a different purpose than that for which it is designed is not a claim for a patent. Thus, it makes no difference what you use an electric light for, it still maintains its original basic patent rights. The same is true of the Neon lamp and whether the Neon lamp is used for signaling purposes, for signs, for flashlights, for airplane beacons or lighthouses, the basic patents cover each and every one of the various usages.

We are of the opinion that many years ago a toy roller-coaster was put on the market, but we have not seen a sample of this for quite some time. We would suggest that you have a search made on the idea, but only if you are in a position to market the product. Many toys have been invented that can find no available markets.

AUTOMOBILE TURN SIGNAL

(1074) John Zeleznik, Bridgeport, Ohio, asks our opinion on a direction signal for automobiles which operates by means of a switch placed on the steering wheel and has a "right" and "left" marker.

A. 1. There are so many hundreds of automobile turn signals of various styles, forms, shapes, etc., on the market that we certainly would not suggest that you apply for a patent on a similar idea.

It is doubtful that you could even cover the suggestion you have made with patent claims of any value. We would not advise further procedure.

GOLF GAME

(1075) Carl Herrmann, Cleveland, Ohio, asks our opinion of a toy golf game in which the different clubs are represented by small heads fitted with levers so that a ball could be pushed by means of these levers; thus, there is a driver, a mashie, etc., each with its own characteristic slope. The table itself is then fitted with trips, holes and different hazards, and the game is to be played the same way as a regular golf game, except that the ball is pushed forward by action of the thumb or finger on the lever.

A. 1. There is on the market today a very interesting indoor golf game which consists of a large putting green which is fitted with the various hazards and made in the form of a cardboard sheet approximately 3 feet by 4½ feet. In addition to this, there are various markers directly on the field and the game is played with miniature clubs and balls. In this way there is a certain skill required. In your particular device there is no more skill required than there would be in shooting marbles, and even less so, because there is an automatic device which is intended to propel the marble and which will always propel it straight in the direction of the aim, with perhaps a variation only in the way a marble will roll after it hits a bunker or the distance over which it will travel, depending on the force of the stroke. The clubs, in our opinion, are of no particular value because the marble will always roll forward and the shape of the clubs will have little effect, nor is there sufficient skill necessitated in handling the devices.

While we are of the opinion that a golf game can find a market, it should be one which presents many of the features of golf and which requires a certain amount of skill in its manipulation.

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The Metal Emperor
By A. MERRITT
(*Continued from page* 895)

stuffs, and covered them both with a fold of blanket, then looked at each other long and silently—and I wondered whether my face was as grim and drawn as his.

"It appears," he said at last, curtly, "that it's up to you and me for a powwow quick. I hope you're not sleepy."

"I am not," I answered as curtly, the edge of nerves in his manner of questioning doing nothing to soothe my own, "and even if I were I would hardly expect to put all the burden of the present problem upon you by going to sleep."

"Don't be a prima donna," he flared. "I meant no offense."

"I'm sorry, Drake," I said. "We're both a little—jumpy."

"It wouldn't be so bad," he answered, "if all four of us were all right. But Ventnor's down and out, and God alone knows for how long. And Ruth—has all the trouble

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we have and some special ones of her own. I've an idea"—he hesitated—" an idea that there was no exaggeration in that story of —what would you call it—possession that she told. An idea that, if anything, she underplayed it."

"I, too," I replied somberly. "And to me it is the most hideous phase of this whole situation—and for reasons not all connected with Ruth," I added.

"Hideous," he repeated. "Unthinkable—yet all this is unthinkable. And still—it *is*. And Ventnor—coming back—that way. Like a lost soul finding voice. Was it raving, Thornton?"

"Ask yourself that question?" I replied. "Man—you know it was truth. Had not an inkling of it come to you even before he spoke? It had to me. His message was little more than an interpretation, a synthesis of observations I, for one, lacked the courage to admit."

"I, too," he nodded. "But why did he command us to go back to the city? How could he know—how could he? And what did he mean about Norhala being their weak spot?"

He moved away from me, and strode over

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to the curtained oval through which Norhala had gone.

"Drake!" I cried, following him, "where are you going? What are you going to do?"

"I'm going after that she devil," he answered, pausing. "I'm going to have a showdown with her, or know the reason why."

"Drake," I cried again, aghast, "don't make the mistake Ventnor did. That's not the way to win through. Don't—I beg you, don't."

"You're wrong," he answered stubbornly. "I'm going to get her. She's got to talk."

He thrust out a hand to the curtains. Before he could touch them they were parted. Out slithered the black eunuch. He stood motionless, regarding us, the ink-black eyes menacing. I pushed myself between him and Drake.

"Where is your mistress, Yuruk?" I asked.

"The goddess has gone," he replied, sullenly.

"Gone?" I said suspiciously, for certainly Norhala had not passed us. "Where?"

"Who shall question the goddess?" he whined. "She comes and she goes as she pleases."

I translated for Drake.

"He's got to show me," he said. "Don't think I'm going to spill the beans, Dr. Thornton. But I'm going to talk to her."

"Yuruk," I said, "we think you lie. We would speak to your mistress. Take us to her."

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"I have told you that the goddess is not here," he said. "If you do not believe, it is nothing to me. I cannot take you to her, for I do not know where she is. Is it your wish that I take you through her house?"

"It is," I said.

"The goddess has commanded me to serve you in all things," he bowed, sardonically. "Follow."

Our search was short. We stepped out into what, for want of better words, I can describe only as a central hall. It was circular, and strewn with thick piled small rugs whose hues had been softened by the alchemy of time into exquisite, shadowy echoes of color, while the cuneiform shape of their woven inscriptions confirmed their ancientness. The walls of this hall were of the same moonstone substance that enclosed the chamber upon whose inner threshold we were. They whirled straight up to the dome in a crystalline, cylindrical core. Four doorways like that in which we stood pierced them. Through each of their curtainings in turn we peered.

All were precisely similar in shape and proportions, radiating in a curved base triangle from the middle chamber; the curvature of the enclosing globe forming back wall and roof; the translucent slicings the sides; the circle of floor of the inner hall the truncating lunette.

The first of these chambers held a half-

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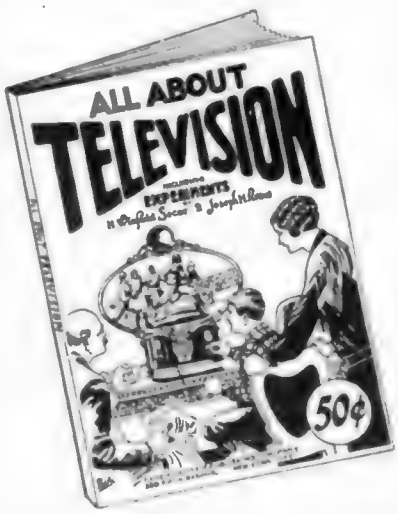

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dozen suits of the lacquered armor and as many wicked looking, short and double-edged swords and long javelins. The second I judged to be the lair of Yuruk. Within it was a copper brazier, a stand of spears and a gigantic bow, a quiver full of arrows leaning beside it. The third room was littered with coffers great and small, of wood and of bronze, and all tightly closed.

The fourth was beyond question Norhala's bedchamber. Upon its floor the ancient rugs were thick. A low couch of carven ivory inset with gold rested a few feet from the doorway. A dozen or more of the chests were scattered about, and flowing over with silken stuffs. Upon the backs of four golden lions stood a high mirror of polished silver. And close to it, in curiously incongruous domestic array stood a stiffly marshaled row of sandals. Upon one of the chests were heaped combs and fillets of shell and gold and ivory, studded with jewels blue and yellow and crimson.

To all of these we gave but a passing glance. We sought Norhala. And of her we found no shadow. She had gone, even as the black eunuch had said, flitting unseen past Ruth, perhaps, absorbed in her watch over her brother, or perhaps through some hidden opening in this room of hers.

Or summoned to her metal master—lover—by that shape I had thought I had seen drop from the back of the Flying Thing?

CHAPTER SIXTEEN
THE ENIGMA

YURUK dropped the curtains, and sidled back to the first room, we after him. We drew the saddle-bags close and propped ourselves against them.

Exposés
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If you know of some hokus-pokus scheme being used to swindle the public—write the Editor about it.

The black eunuch squatted a dozen feet away, facing us, chin upon his knees, taking us in with blank, unblinking eyes. He dropped his eyes and began a slow, curious motion of his long arms, the hands running along the floor upon their talons in arcs.

It was curious how those hands seemed to be endowed with a volition of their own, independent of the arms upon which they swung. And now I could see only the hands, shuttling so smoothly, so rhythmically back and forth—weaving so sleepily, so sleepily back and forth—

Black hands that dripped sleep—

I broke the lethargy closing upon me. Drake's head was nodding—nodding in time to the movement of the black hands. I jumped to my feet, shaking with an anger unusual to me, and thrust my pistol into the wrinkled face.

"Damn you!" I cried. "Stop that! Stop it and turn your back!"

The corded muscles of the arms contracted; the claws of the slithering paws drew in. He could not have known what was the tube with which I menaced him; but he sensed its threat. Sneering, he squattered about, wrapped his arms around his knees and crouched with his back toward us.

"What's the matter?" asked Drake, drowsily.

"He tried to hypnotize us," I answered. "And pretty nearly did it."

"So that's what it was!" He was wide awake. "I watched those hands of his, and got sleepier and sleepier—I guess we'd better tie Mr. Yuruk up."

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The cry of the leper—outcast, unclean! A soul-wracking, melancholy cry that has resounded in the halls of time since Egypt was young and the pyramids were but a dream.

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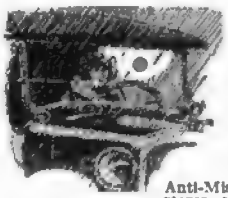

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"No," I said, "No. He's safe enough as long as we're on the alert. I don't want to use any force on him, yet. Wait until we know we can get something worth while by doing it."

"All right," he nodded grimly. "But when that time comes I'm telling you straight, Professor, I'm going the limit. From splinters under his nails and gunpowder under his skin. There's something about that human spider that makes me itch to squash him—slowly.."

"I'll have no compunction, Drake—when it's worth while," I answered.

We sank down again against the saddlebags; he brought out a black pipe, looked at it sorrowfully; at me wistfully.

"All mine was on the pony that bolted," I answered his appeal.

"All mine was on my beast, too," he sighed. "And I lost my pouch in that spurt from the ruins."

He sighed again and clamped down upon the stem.

"Of course," he said at last, "if Ventnor was right in that—that disembodied analysis of his, it's rather—well, terrifying, isn't it?"

"It's all of that," I replied, "and considerably more."

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"Metal, he said," Drake mused. "Things of metal with brains of thinking crystal, and their blood the lightnings. You accept that?"

"So far as my own observation has gone—yes," I said. "They are metallic, yet mobile. Crystalline, of course, in structure and highly complex. Activated by magnetic-electric forces consciously exerted, and as much a part of their life as brain energy and nerve currents are of our human life. Animate, moving, sentient combinations of metal, crystal and electric energy."

He said:

"The opening of the disc from the globe, and of the two blasting stars from the pyramids show the flexibility of the outer-plate would you call it? I couldn't help thinking of the armadillo after I had time to think at all."

"It may be"—I struggled against a conviction now strong upon me—"it may be that within that metallic shell is an organic body, something soft—animal, as there is within the horny carapace of the turtle, the nacreous valves of the oyster, the shells of the crutaceans—it may be that even their inner surface is organic—"

"No," he interrupted, "if there is a body—as we know a body—it must be between the outer surface and the inner, for the lat-

ter is crystal, jewel hard, impenetrable."

"What makes you so sure?" I asked.

"Ventnor's bullets hit fair," he said. "I saw them strike. They did not richochet—they dropped dead from that shining thing. Like flies dashed up against a rock—and it was no more conscious of their striking than a rock would have been of those same flies."

"Drake," I said, "my own conviction is that these creatures are absolutely metallic, entirely inorganic, as we understand that term—incredible, unknown forms. Let us go on that basis."

"I think so, too," he nodded, "but I wanted you to say it first. And yet—is it so incredible, Dr. Thornton? What is the definition of vital intelligence—sentience?

"Haeckel's is the accepted one," I said, "Anything which can receive a stimulus, that can react to a stimulus and retain memory of a stimulus must be called an intelligent, conscious entity. The gap between what we have long called the organic and the inorganic is steadily decreasing. Do you know of the remarkable experiments of Lillie upon metals?"

"Something," he answered.

"Lillie," I went on, "proved that under the electric current and other exciting mediums, metal exhibited practically every reaction of the human nerve and muscle. It grew weary, rested, and after resting was perceptibly stronger than before. It got what was practically indigestion, and it exhibited a peculiar but unmistakable memory. Also it could acquire disease, and die.

"Lillie concluded that there existed a real metallic consciousness. It was Le Bon who first proved that metal also is actually more sensitive than man, that its immobility is only apparent.

"Take the block of magnetic iron that stands so grey and apparently lifeless, subject it to a magnetic current, and what happens? The iron block is composed of molecules which under ordinary conditions are disposed in all possible directions indifferently. But when the current passes through there is tremendous movement in that apparently inert mass. All of the tiny particles of which it is composed turn and shift until their poles all point more or less approximately in the direction of the magnetic force.

"When that happens the block itself becomes a magnet, filled with and surrounded by a field of magnetic force. It is instinct with it. Outwardly it has not moved; actually there has been prodigious motion."

"But it is unconscious motion," he objected.

"Ah, but how do you know it is?" I asked. "If Jacques Loeb was right, that action of the iron molecules is every bit as conscious a movement as the least, and the greatest, of our own. There is absolutely no difference between them. Loeb—all he did was to restate destiny, one of humanity's oldest ideas, in the terms of tropisms, infusoria and light. Loeb was Omar Khayyam chemically reincarnated in the Rockefeller Institute. Nevertheless, those who accept his theories have to admit that there is essentially no difference between their impulses and the rush of filings toward this magnet."

"The block of iron meets all of Haeckel's three tests—it can receive a stimulus, it reacts to that stimulus, and it retains memory of it. For even after the current has ceased, it remains changed in tensile strength, conductivity and other qualities that were modified by the passage of that current. And as time passes, this memory fades. Precisely as some human experience increases wariness and caution, which keying up of qualities remains with us after the experience has passed, and fades away in the ratio of our sensitivity plus retentiveness divided by the time elapsing from the original experience—exactly as it is in the iron."

"Granted," he acquiesced. "We now come to their means of locomotion. In its simplest terms, all locomotion is progress through

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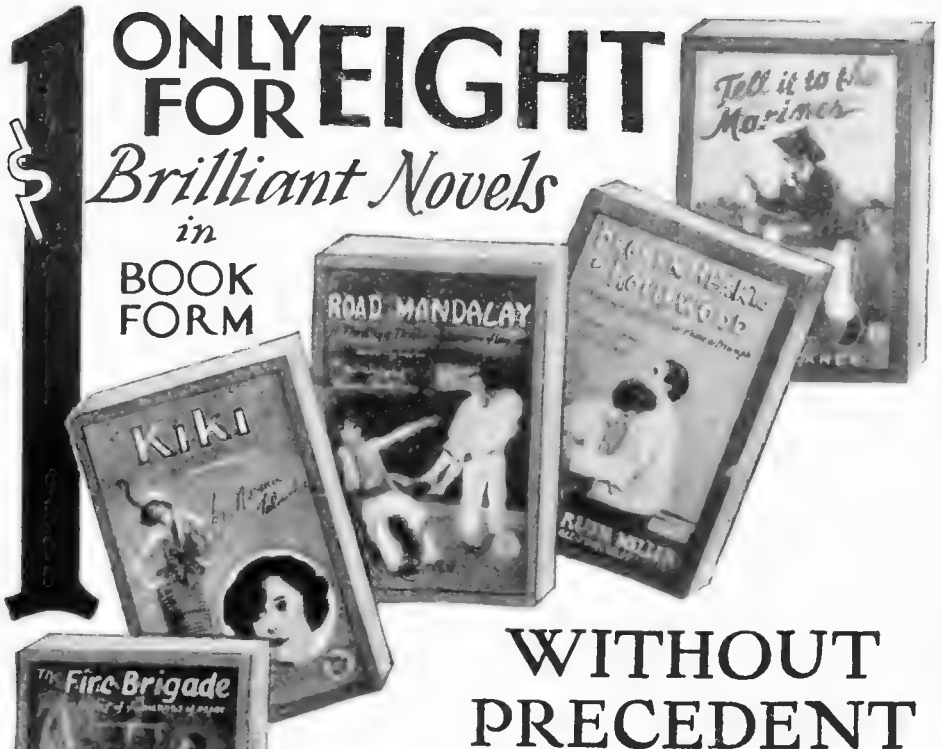

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space against the force of gravitation. Man's walk is a series of stumbles against this force that constantly strives to drag him down to earth's face, and keep him pressed there. Gravitation is a magnetic vibration akin to the force which holds, to use your simile again, the filings against the magnet. A walk is a constant breaking of the current. Take a motion picture of a man walking and run it through the lantern rapidly—and he seems to be not walking but flying. We have none of the awkward fallings and recoveries that are the tempo of walking as we see it."

"I take it," I said, "that the movement of these Things is a conscious breaking of the gravitational current just as much as is our own movement, but by a rhythm so swift that it appears to be continuous."

"If we could so control our sight as to admit the vibrations of light slowly enough," he agreed, "we would see their apparently smooth motion as a series of leaps—just as we do when the motion-picture operator slows down his machine sufficiently to show us walking in the series of stumbles.

"Very well," I said, "so far, then, we have nothing in this phenomenon which the human mind cannot conceive as possible. Therefore, intellectually, we still remain masters of the phenomenon. For it is only that which human thought cannot encompass which it need fear."

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"Metallic," Drake said, "and crystalline! And yet—why not?—why not? What are we but bags of skin filled with certain substance in splution and stretched over a supporting and mobile mechanism largely made up of lime? Out of that primeval jelly which Gregory calls protobion we came, after untold millions of years, with our skins, our nails, and our hair; came, too, the serpents with their scales, the birds with their feathers; the horny hide of the rhinoceros and the fairy wings of the butterfly; the shell of the crab, the gossamer loveliness of the moth and the shimmering wonder of the mother-of-pearls. Is there any greater gap between any of these and us and the metallic? I think not."

"Not materially," I answered. "No. But there remains—consciousness."

"That," he said, "I cannot understand. Ventnor spoke of—how did he put it—a group consciousness, operating in our sphere and in spheres above and below ours, with senses known and unknown. I get glimpses—but cannot understand."

"We have agreed, for reasons that seem sufficient to us, to call these things metallic, Drake," I replied. "But that does not necessarily mean that they are composed of any metal that we know. Nevertheless, being metal, they must be of crystalline structure. As Gregory has pointed out, crystals, and

what we call living matter and an equal start in the first essentials of life. We cannot conceive life without giving it the attribute of some sort of consciousness. Hunger cannot be anything but conscious, and there is no other stimulus to eat but hunger.

"The crystals eat. The extraction of power from food is conscious because it is purposeful, and there can be no purpose without consciousness. Similarly the power to work from such derived energy is also purposeful and therefore conscious. The crystals do both. And the crystals can transmit all these abilities to their children, just as we do. For although there would seem to be no reason why they should not continue to grow to gigantic size under favorable conditions—yet they do not. They reach a size beyond which they do not develop. Instead, they bud—give birth, in fact—to smaller ones, which grow and increase precisely as their progenitors.

"Very well, then—we arrive at the conception of a metallically crystalline being, which by some explosion of the force of evolution has burst from the, to us, familiar and apparently inert stage, into these creatures that hold us. And is there any greater difference between the forms with which we are familiar and them, than there is between us and the crawling amphibian which was our remote ancestor? Or between that and the amoeba—the little swimming stomach from which it evolved? Or the amoeba and the inert jelly of the protobion?

"As for what Ventnor calls a group consciousness I would assume that he means a communal intelligence, such as that shown by the bees and the ants—that which, in the case of the former, Maeterlinck calls the 'spirit of the Hive.'"

"But metal!" Drake mused, "and conscious! It's all very well—but where did that consciousness come from? And what is it? And where did they come from? And —why haven't they overrun the world? Such development as theirs, such an evolution, pre-supposes aeons of time—long as it took us to drag up from the lizards. What have they been doing—why haven't they been ready to strike—if Ventnor's right—at humanity until now?"

"I don't know," I answered, helplessly. "But evolution is not the slow, plodding process that Darwin thought. There seem to be explosions—nature will create a new form almost in a night. It might be so of these—some extraordinary conditions that shaped them. Or they might have developed through the ages in spaces within the earth —there's that abyss we saw that is evidently one of their highways. Or they might have dropped here upon some fragment of a broken world, found in this valley the right conditions and developed with amazing rapidity. They're all possible theories—take your pick."

"You think then that these things are made up of myriads of tiny specialized crystals, just as our own bodies are made up of myriads of tiny specialized cells?"

"That's it in a nutshell."

"Something's held them back—and they're rushing to a climax," he whispered. "Ventnor's right about that—I feel it. And what can we do?"

"Go back to the city," I answered. "Go back as he ordered. It wasn't just a request he made, nor even an appeal—it was a command."

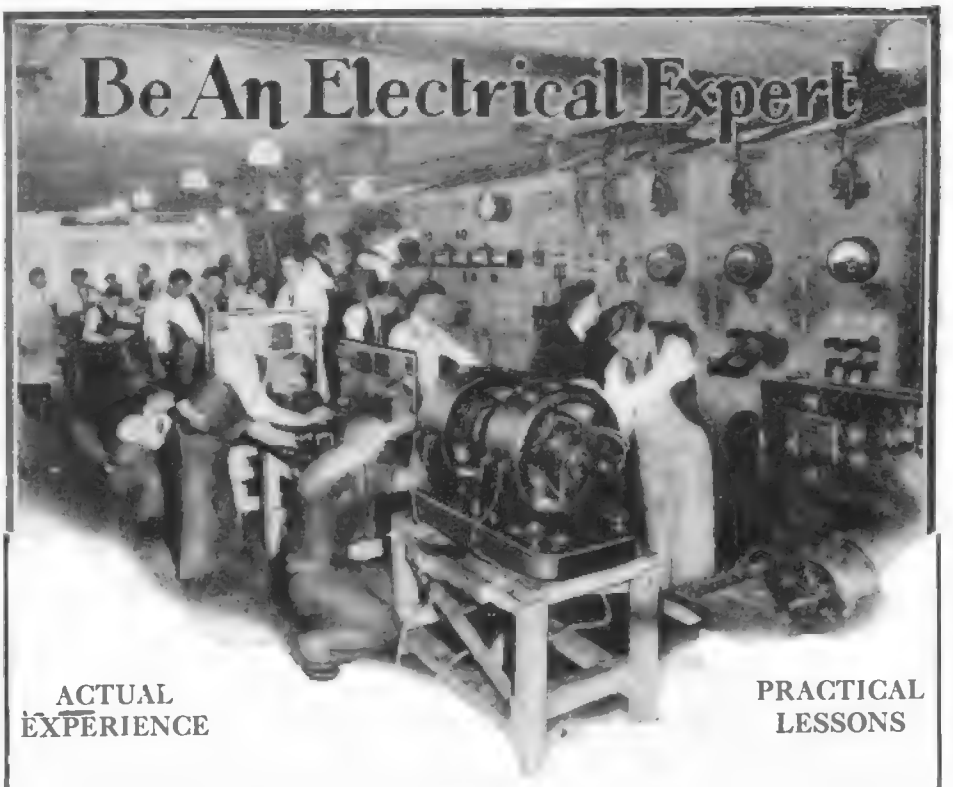
"It was more than that," said Drake, slowly. "But what can we do against—them?"

"That we may find out—when we're in the city," I answered.

"Well," said Drake, some of his old cheerfulness breaking through, "in every crisis of this old globe it's been up to one man to turn the trick. We're two."

For a time we were silent.

"Well," I said at last, "we have to go to the city in the morning."



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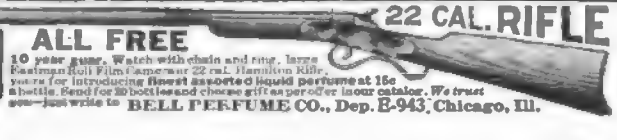

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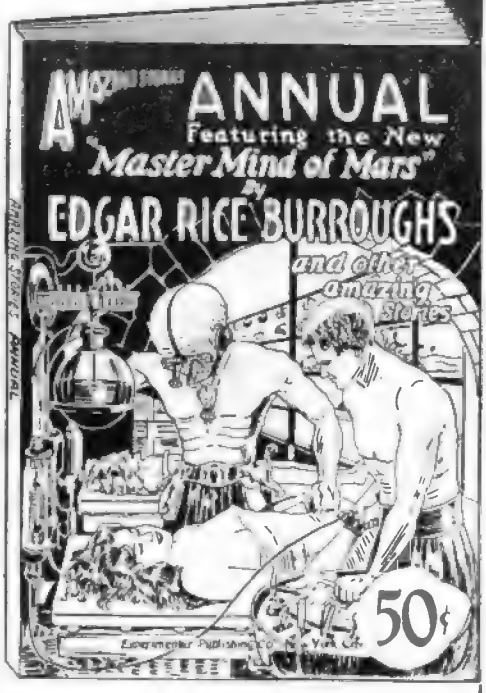

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"You sound as though we were living in the suburbs and had to catch the 9:15," he remarked.

"It can't be many hours before dawn," I said. "Turn in for awhile, I'll wake you when I think you've slept enough."

"It doesn't seem fair," he protested, but sleepily.

"I'm not tired," I told him. Whether I was or was not, I wanted to question Yuruk, uninterrupted and undisturbed. Drake stretched himself out, head boring about for the softest spot in his saddle-bag.

When his breathing showed him fast asleep, I slipped over to the eunuch and crouched, right hand close to the butt of my automatic, facing him.

CHAPTER SEVENTEEN
YURUK

"YURUK," I whispered, "you love us as the wheat loves the hail. We are as welcome to you as the cord to the condemned. Lo, a door opened into a land of unpleasant dreams and we came through it. Answer my questions with truth, and it may be that we shall return through that door."

He stared at me, eyes suddenly bright.

"There is a way from here," he muttered. "I can show it to you."

"Where does that way lead?" I asked, not blind to the flash of malice that had shot across the wrinkled face. "There were men who hunted us, men clad in armor with javelins and arrows. Does your way lead to them, Yuruk?"

For a time he hesitated, the lashless lids half closed.

"Yes," he said sullenly. "The way does lead to them. But will it not be safer for you there—among your kind?"

"I don't know that it will," I answered. "Those who are unlike us smote those who are like us and saved us from their chains. Why is it not better to remain here, than to go to our kind who would destroy us?"

"They would not," he said. "If you gave them—her." He thrust a long thumb backward toward sleeping Ruth. "Cherkis would forgive much for her."

He leered at me.

"Besides," he added, "have you no arts to amuse him?"

"Cherkis?" I asked.

"Cherkis," he whispered. "Is Yuruk then a fool not to know that in the outer world new things must have arisen since long ago we fled from Iskander into the secret valley? What have you to take to Cherkis beside this woman flesh? Much I think. Then go to him—unafraid."

"Yuruk," I asked, "is she whom you call goddess—Norhala—of the people of Cherkis?"

"Long ago," he answered; "long, long ago there was trouble in their city, even in Ruszark, the great dwelling place of Cherkis. I fled with her who was the mother of the mother of the goddess. There were twenty of us; and we fled here—by the way which I will show you—"

He waited, but I gave no sign.

"She who was the mother's mother of the goddess, found favor in the sight of the ruler here," he went on. "But after a time she grew old and ugly and withered. So he slew her. Like a little mound of dust she danced, and blew away after he had slain her. Also he slew others who had grown displeasing to him. For a time she who was the mother of the goddess delighted him. Then she grew old, and her also he slew. And this time he blasted me—as he was blasted—" he pointed to Ventnor.

"Then it was that, recovering, I found my crooked shoulder. But years before that the goddess was born. He who is ruler here visited her mother often, and she is kin to him—certainly. How else could she shed the lightnings? Was not the father of Iskander the god Zeus Ammon, who

came to Iskander's mother in the form of a great snake? Well? The goddess was born—shedder of the lightnings even from her birth! And she is as you see her.

"He-he!" he chuckled. "He-he! They grew old and they were slain. But I who am indeed old hide when they come. And so I live. He-he!

'Cleave to your kind! Cleave to your kind!" croaked the black eunuch. "Better is it to be flayed by your brother than to be eaten by the tiger! Cleave to your kind! Look—I will show you the way."

He sprang to his feet clasped my wrist in one of his long hands, led me through the curtained oval into the cylindrical hall, parted the curtainings of Norhala's bed room, pushed me within, and pressed against the farther wall.

An ovoid slice slid aside, revealing a wide doorway. I glimpsed a path, a trail, leading into a forest pallid green beneath the wan light.

"Follow it," he pointed. "Take those who come with you and follow it before—They —slay you."

The wrinkles upon his face writhed with his eagerness.

"You will go?" panted Yuruk. "You will take those who came with you and go by that path?"

"Not yet," I answered absently. "Not yet."

And he was abruptly brought to full alertness, vigilance, by the flame of rage that filled his eyes.

"Lead back," I directed curtly. He slid the door into place, and turned sullenly. I followed, wondering what were the sources of the bitter hatred he so plainly bore for us, the reasons for his eagerness to be rid of us despite the commands of this woman who to him at least was goddess.

And by that curious human habit of seeking for the complex when the simple answer lies close I failed to recognize that it was only jealousy that was the root of his behavior; that he wished to be, as it would seem he had been for years, the only human being near Norhala. Yes, I failed to realize this, and with Ruth and Drake was terribly to pay for that failure.

I looked down upon the pair, sleeping soundly and upon Ventnor lost still in trance.

"Sit!" I ordered the eunuch. "And turn your back to me again."

As he obeyed, a question long deferred at last found utterance.

"Yuruk," I asked, "whence came this house in which we are? Who built it?"

"The ruler here," he answered sullenly. "He made it for the delight of the mother of the goddess. And slew her. Never forget that—he slew her!"

I dropped down beside Drake. Glibly enough I had passed over his questioning as to the consciousness of the Metal People. How I faced it, knowing it to be the very crux of these phenomena, admitting, too, that despite all my special pleading it was about this point the thickest mists of uncertainty whirled in my own mind.

That the sense of order possessed by the creatures was immensely beyond man's was plain. Just as plain was it that their knowledge of magnetic force and its manipulation were beyond the sphere of humanity. That they had realization of beauty this palace of Norhala's proved—and no human imagination could have conceived it nor human hands have made its thought of beauty real.

And consciousness itself—after all what is it?

A secretion of the brain? The cumulative expression, wholly chemical, of the multitudes of cells that form us? The inexplicable governor of the city of the body of which these myriads of cells are the citizens—and created by them out of themselves to rule?

It is what many call the soul?

Or is it but a finer form of matter, a self-realizing force, which uses the body

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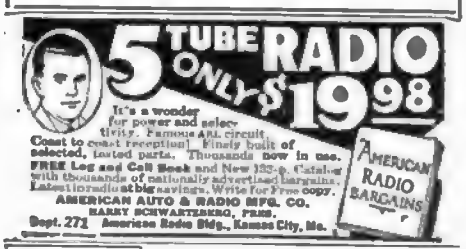
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as its vehicle as other forces use for their vestments in other machines?

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Is there a sea of this conscious force which laps the shores of the farthest-flung stars; that finds expression in everything—man and rock, metal and flower, jewel and cloud? Some energy limited in its expression only by the limitations of that which it animates, and which in essence is the same in all.

If so, then this problem of the consciousness of the Metal Horde ceased to be a problem, for it was answered.

So thinking I became aware of increasing light, strode past Yuruk to the door and peeped out. Dawn was paling the sky. I stooped over Drake and awakened him.

"I only need a little sleep, Dick," I said. "When the sun is well up, call me."

"Why, it's dawn," he said. "Professor, you oughtn't to have let me sleep so long. I feel like a damned pig."

"Never mind" I answered. "But watch Yuruk close."

I rolled myself up in his warm blanket and sank almost instantly into a dreamless slumber.

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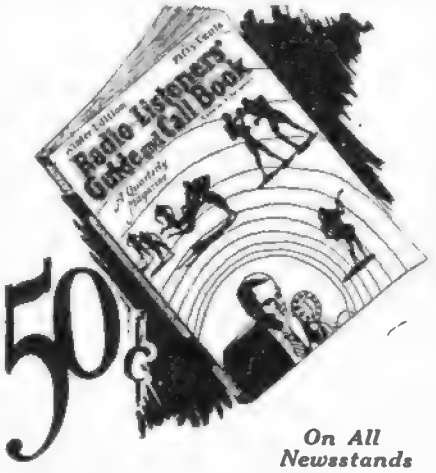

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By S. R. WINTERS

(*Continued from page* 891)

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Alarm Clock Case from Wall-Board

By H. L. WEATHERBY

(*Continued from page* 906)

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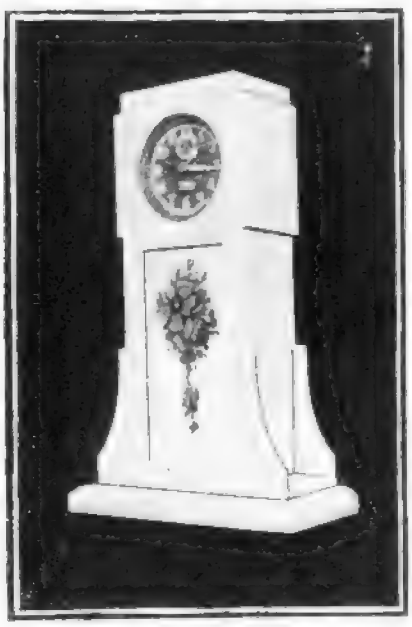

Appearance of finished alarm clock case.

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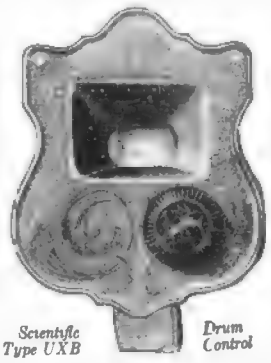

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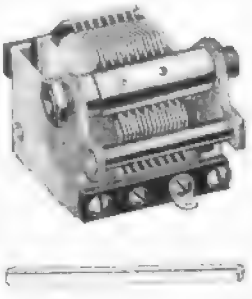

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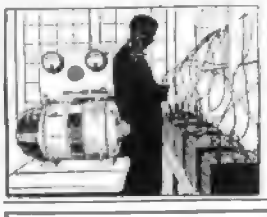

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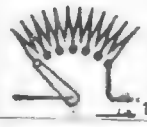

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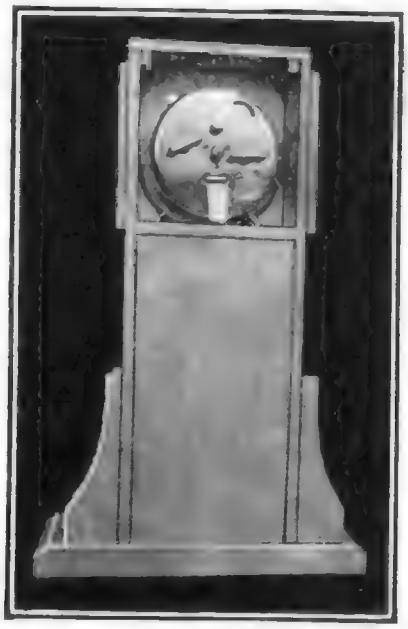
has been allowed to dry, the edges of the curves and other places needing it may be sanded lightly to smooth them, or even the careful use of a file will prove to be of considerable aid in removing the bumps in the curves that have possibly been left by the coping saw. Follow this with two or more coats of the desired color lacquer. As a finishing touch, add a transfer decoration to the panel. These transfer designs can be purchased from any paint store and are easily applied.

The result will be very gratifying and the old alarm clock or the new one, as the case may be, will be housed in a cabinet suitable to adorn any room in the house.



How alarm clock case looks from the rear.

Easy Experiments in Chemistry

By RAYMOND B. WAILES

(*Continued from page* 909)

cium compounds, but allows the flame color of potassium to come through, it appearing crimson. The bottle of solution is held about two inches from the flame, with the substance to be tested on the usual platinum or infusible alloy wire in the flame.

AN AMALGAM EXPERIMENT

Amalgams are alloys of mercury and another metal. Platinum and aluminum do not readily amalgamate, or alloy with mercury, as can be evidenced by trituating a

This white mass "grew" from the surface of the aluminum sheet, which was previously rubbed with sodium amalgam.

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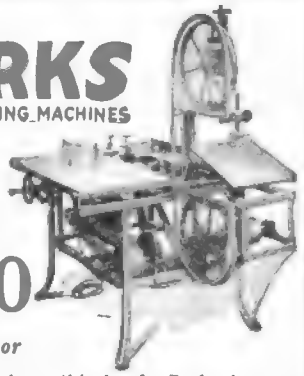

You ought to have this handy Parks in your shop. It is a compact, complete machine designed just like a big production outfit at one-fifth the cost. Includes 8-inch circular rip and cross cut saw with polished cast-steel saw table, 16-inch band saw with tilting table for bevel-sawing, 6-inch jointer, and motor operating from any light socket. Just plug in and go to work! Fits in a corner of your basement. Does any kind of cabinet and joinery work. Add lathe, shaper and other attachments any time at small cost. For the man who does "odd jobs" in his off time this Parks is a big money maker. Turn out as much as a four-man shop working by yourself.

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globule of mercury with a freshly cut shaving of aluminum. Mercury will combine with sodium, often very violently. Such a product is called sodium amalgam and if a bit of this ashy-looking alloy be rubbed on a clean sheet of aluminum, nothing can be seen. In several minutes, however, if the air be moist, a bit of activity can be seen taking place where the sodium amalgam was rubbed. Shiny globules appear, and from these a growth of aluminum oxide forms, often rising about an inch above the aluminum plate. The photograph shows how the oxide appears after several hours. The only treatment that the plate received was cleaning with steel wool and a scratching of its surface with a bit of sodium amalgam.

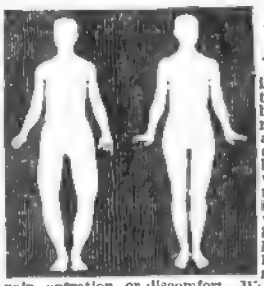
Making a large cork smaller — Rolling a large cork under the sole of the shoe will compress it so as to make it fit into a small bottle. Put stiff paper on the floor and over the cork to keep it clean.

Model Ship and Clock Novelty

THE popularity of ship models has been increasing for the last year or so, and one prominent Philadelphia manufacturer combined a loud speaker and ship model, which was useful, as well as being decorative. This model has further been improved by the addition of a clock, which is placed in one side of the hull of the boat. Many people have found it inconvenient to place their speaker in a conspicuous part of the room, such as on the mantel, because of the fact that the place was already occupied by a clock of some sort. This nuisance is now obviated by the introduction of the clock-ship model loud speaker. These speakers may be had at various prices, according to the size and type of ship. Some of the model ships have small electric lights inside of the hull and when the room is darkened, the port holes emit a glow, which produces an extremely artistic and life-like appearance. The units in the speakers reproduce radio programs with fidelity, clearness and good volume.

The new model ship speaker, with clock, is shown in the above photograph. These clocks are available in one or eight-day movements.
—Photo Courtesy Miniature Ship Models.

PERSONAL Appearance



is now more than ever the keynote of success, both in social and business life. Bow-Legged and Knock-Kneed men and women, both young and old, will be glad to hear that my new appliance will successfully straighten, within a short time, bow-leggedness and knock-kneed legs, safely, quickly and permanently, without pain, operation, or discomfort. Worn at night. My new "Limstraitner," Model 18, U.S. Patent, is easy to adjust; its results will soon save you from further humiliation, and improve your personal appearance 100 per cent. (Model 18 is not like old-fashioned splints or braces, with bothersome straps, hard to adjust, but a scientific, modern device of proven merit, used and recommended for the last 7 years by physicians everywhere.) Write today for particulars, testimonials, and my free copyrighted physiological and anatomical book which tells you how to correct bow and knock-kneed legs without any obligation. Enclose dime for postage.

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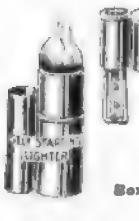

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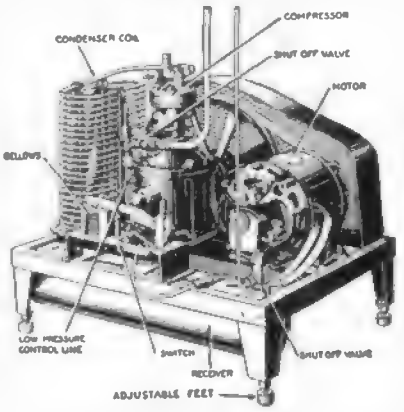

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Readers Forum

(*Continued from page 915*)

rooming house, and his daughter having married and is now living with a family in the poorest shack in town. She is both in rags and need. Now I realize that I should have stayed at the farm and married the farmer's daughter. B. ABENDROTH,
Boise, Idaho.

(From your letter we believe that the fortune teller told you many other things which did not take place, as well as those which, by coincidence, did. Also, like all of these coincidences, they are magnified considerably after they occur.

Isn't it possible that you are over-estimating your ability when you say that because you did not take the job, the farm was sold? Don't you suppose that there are others who could have done the work equally as well? Why then consider that the place was sold because you did not stay there and work when so requested? Why believe that you would have been happy with the farmer's daughter? Are there not others who could have made her happier? This all brings us down to the question as to why you should consider yourself a failure. Do you consider any man a failure who does not take a chance on every job which is offered him? Many of us are daily turning down situations because they are either too promising or not promising enough. Some of these that are not promising enough ultimately become little short of phenomenal. Some of those that were exceptionally promising terminate worthlessly.

At the time you were not interested in the job you did not think of future possibilities; you did not believe that the situation held any promise of success whatever—otherwise you would have remained there. Does the fact that, the farm was sold in later years, indicate that the land held out promises for the future? If the property was so valuable, could not a portion of it have been sold to cover the amount of taxes; could not the husband of the farmer's daughter have managed the place as well as yourself? If you are going to wait until the fortune teller gives you a promising future, and then expect to get it, you have many days of unemployment before you. It is easy enough to get a good fortune from the fortune teller; but it is not so easy to expect the world in general to live up to the fortune teller's promises. It is easier to put your shoulder to the wheel and work for your fortune than it is to sit idly by and wait for Dame Fortune to turn her charming finger in your direction.—EDITOR.)

NO MODELS?

Editor, SCIENCE AND INVENTION:

I have been taking SCIENCE AND INVENTION Magazine for a year, and I think it is an excellent paper for items of scientific interest. I think, however, it could be improved upon. In my opinion, the "Model Department" could be discontinued without any serious damage to the magazine. This is not science; it is only woodwork. Why not keep the paper to its title: "We only want items of scientific value." Again, the page "Magic by Dunninger?" is not science. It is an illusion of the eye due to trickery. Also, "The Constructor" page has no especial scientific interest. I am pleased to read that the "Wirekraft" and "Matchcraft" contests are discontinued. I quite realize the difficulty with which an editor is faced in trying to meet the approval of all his readers, but I am sure that if some of these alterations were made, they would meet the approval of the majority of your readers.

Hoping this letter will receive your consideration in due course, I remain,

D. H. BROMWICH,
Highfields, Leicester, England.

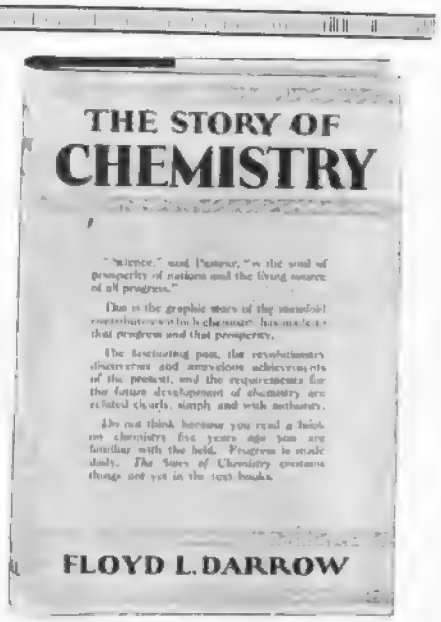
(It seems that there are more readers who prefer the departments not liked by Mr. Bromwich than those who disapprove of them. As a matter of fact, the last vote firmly established the departments to which Mr. Bromwich objects. We are always glad to hear what our readers prefer. It is only by their letters that we are able to determine the type of material which should consistently appear in this publication.

What do other readers prefer?—EDITOR.)

MOTION PICTURE BOOKS

Editor, SCIENCE AND INVENTION:

By a simple process, books can be illustrated by moving pictures. First, a moving picture of the process to be illustrated is taken. The films are developed and prints are made of the strip of film. These prints are printed in the book, on the outside edge of the page, occupying about one square inch of space, a different print being shown on each page, so that all the pages throughout the book have a one-inch-square picture on the edge. By taking hold of the book with the thumb and forefinger and letting the pages fly by rapidly, the picture will be seen in motion. The reader can stop at any single page to view closely some step in the process. If a prolongation of the moving pictures is required, more than one square can be placed on a page; or the whole edge of each page in the book can be filled with squares of pictures, one under the other, mak-



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14	
1	
19	
8	

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19	
5	
4	
1	
14	

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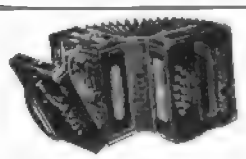

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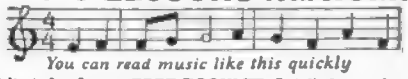

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ing several rows. After one set of pictures is run through and viewed, the reader can look at the set of pictures under that one, and then go to the next one underneath, until the whole book is covered from the top of the page to the bottom. Then, if more space is needed, the other side of the page can be used, so that the entire edge of both right-hand and left-hand pages can be filled with pictures, and the reader can turn the pages from left to right, and when finished on that side, turn the pages from right to left, viewing the other side.

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ABRAHAM FRIEDMAN,
New York City.

(While it is true that such a system as you cite would be of vast interest to a great many readers, particularly in demonstrating the way in which internal combustion engines operate and the way in which the telephone receiver and transmitter work, you will note that in rapidly passing through the pages of this publication the numbers of the pages jump all over. Now, while each page number is practically the same distance away from the edge of the book, be that SCIENCE AND INVENTION Magazine, or any novel which you may pick up, when the book is bound and trimmed, the margins are not even throughout the volume. Modern high-speed presses and high-speed book-bindery, as well as modern methods of high-speed folding of paper, do not permit of perfect alignment of type on repeated pages. It, therefore, would be necessary to print books of this nature on very accurately registered plates, making the price of a magazine of the nature of SCIENCE AND INVENTION entirely too expensive for motion picture edges. It might be of advantage for some organizations to make up small booklets demonstrating, in motion picture form, their process of manufacture, and materials, or the operation of some of their products. Current periodicals and books could hardly use the system.—EDITOR.)

Have You Read the

"Hints for the Mechanics" Department

SEE PAGE 930

Send in your ideas to the Editor of that Department

BACKS OUR IONACO EXPOSÉ

Editor, SCIENCE AND INVENTION:

I am a reader of SCIENCE AND INVENTION Magazine and have been for considerable time. I fail to understand why some people, as in the case of the person who addressed the editor as Bright Eyes, can still see any sense in an explanation such as is given by the ones who make the "magic belts." I wish to say that at least 90% of the people, who were "cured" by this wonderful belt, were not cured because the iron in their blood was ionized, or whatever it is called, since the iron contained in our system is not metallic iron, therefore it cannot be magnetically attracted, and that is where they claim the real cure is started. Most of the users of the Ionaco or any other "belt" would be highly insulted if they were told that they were cured by auto-suggestion. This, however, is the only really logical explanation, since there is little if any heat generated by the coil.

There are many old people who are using these contraptions who were bamboozled into the idea that their iron was getting rusty, or some other fool notion and then through high sounding words and adroit phrases, false testimonials, or other underhand means, exchanged their little savings for a worthless bundle of wire. I have heard these agents on the street cars, where I worked, make such remarks as, "Well, I put over three more in the last week," or "Had another one come back, but I have several more good prospects." Winks and wise looks accompanied these remarks nearly every time.

However, it is as you say—if the Ionaco was so good, why did the one who invented it die of one of the things which was so easily cured?

Personally, I think Barnum was right; as for the Wichita person, he is merely ignorant and was afraid to sign his name to his letter.

I say more power to the best magazine in the world; I enjoy every issue and the only thing about it that I don't like is, that it does not come oftener.

Only one more thing I want to say in regard to the Ionaco agent at Wichita, and that is, that he could certainly not be trusted by me, let alone trusting a large publishing company, with a coil of copper wire. I don't suppose you need one do

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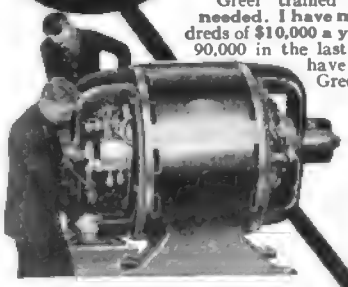

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you? If so, let me know, I might find some people here, who would like very much to have their money back.

Thanking you, I am

J. L.
Los Angeles, Calif.

(No, Jack, we do not need an Ionaco. Before we investigated this subject, we purchased one at the regular price, from a recognized dealer. We knew that it was a genuine Ionaco because, as all Ionaco dealers tell us, it had the oval seal indicating its genuineness. We then ripped the cover off and removed the wrapping, after which we discovered what the apparatus contained, although we had a very good idea of its make-up before the investigation.

Following that, we examined other apparatus and found out that the manufacturers were not even consistent in the number of turns they put in the Ionaco.

If Gaylord Wilshire had survived after using the Ionaco, we would have had another testimonial letter. The unfortunate factor is that he died of the very ailments for which this horse collar was supposed to be a specific. This information has been suppressed in all Ionaco advertising, as it would never do to let the people of the United States know that the inventor died of one of the very ailments which his apparatus was supposed to cure.—EDITOR.)

MENTAL DISEASES

Editor, SCIENCE AND INVENTION:

Having had some unusual experiences with patients, I am prompted to ask you to answer if possible, the following questions for which I enclose postage.

1. Is it possible for radio broadcasters to effect contact with individuals, sensory, auditory, televisionary, by means of metallic or other tissue, inoculations, or without such inoculations, and in such degree and force as to produce reactions which may be termed or construed as communication?
2. What in brief is the process?
3. What literature on this subject, if any, is available and where?
4. How may legally conclusive evidence of such a process surreptitiously applied to an individual, be obtained?

Thanking you, I remain

DR. HENRY B. SULLIVAN,
Detroit, Mich.

1. It is not possible for radio broadcasters to affect any individual or produce any sensation in an individual whether that sensation be auditory, mental, olfactory, televisionary or sensory. The human ear is not and cannot be tuned to such a point that it will automatically pick up radio signals which travel at such high frequencies. A detector of some kind or another is necessary. It is, coincidentally, impossible to send out these messages by any other method than radio over considerable distances and by induction over short distances. The human body does not react to inductive electrical fields.

2. Inasmuch as the system is impossible, there can be no process.

3. The only literature available is that found in books on psychopathia, as this disposition is undoubtedly associated with a psychopathic condition.

4. Conclusive evidence could not be obtained of a process that is not in existence. If such a process were in existence, you may rest assured that the editors of SCIENCE AND INVENTION Magazine and RADIO NEWS, who know practically every advance in the radio field, would know of the apparatus. It further follows that such apparatus if it could be produced, would immediately put all telephonic communication out of business. It would prevent the establishment of radio transmitting stations and it would enable anybody in the United States to listen to anyone else without the aid of apparatus.—EDITOR.)

TO MARS

Editor, SCIENCE AND INVENTION:

There has been quite a hit of comment (some of it caustic) upon Lindbergh's recent flight to Paris, the flights to Hawaii, etc. I do not want to "kick" about these record-breaking feats in aviation, for I realize their value, but I do want to make a suggestion.

Millions of miles away is the red planet, Mars. Interest has centered in this planet since 1877, when Schiaparelli discovered the "canali." For some time, interplanetary travel has been a favorite subject for "scientific" prophets and for fiction writers. Jules Verne, in his novel, "Earth to the Moon," used a passenger-carrying projectile. Recently a professor in Clark University planned to send a high-speed rocket to the moon (not passenger-carrying, however.) Why not use a large, passenger-carrying rocket of the high-speed type, send it to Mars, and make this dream of interplanetary exploration a reality? I know that this sounds absurd in the extreme, and that there are quite a number of problems confronting such an attempt, but this isn't any more absurd than the dream of the airplane seemed about one hundred years ago. A hydraulic method of shock absorption will solve one of the problems. I believe that interplanetary travel is possible, and that it will come ultimately, so why not attempt it now? Such an attempt will be costly, and here is an opportunity for some wealthy person to obtain a place in the world's "Hall of Fame," by financing such an expedition. By using the rocket, a return trip might be possible. Such an exploring trip should be of much benefit. If I had the means, I would gladly finance the trip myself; however,

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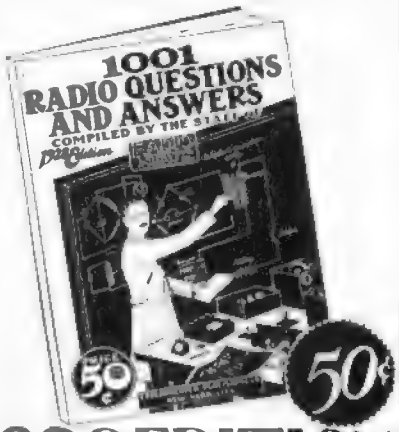

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if the rocket is built and equipped as I would like to have it, I would be more than willing to go inside it, even if it were necessary for me to go alone.

M. Franklin,
Cape Girardeau, Mo.

(There is no doubt but that when Professor Goddard releases his rocket and this rocket is loaded with a sufficient amount of powder to propel it across the intervening space, that the rocket will strike the moon. There is also an equal possibility that we may eventually build a large mechanism capable of sending a man to Mars. Such plans are not only within the realm of our imagination, but they are also within our constructive powers. The difficulty in such a proposition is the cost of construction of a mechanism and our decided lack of knowledge of the atmosphere of interstellar space.

Of course, we know what to expect, but no man has ever travelled into these uncharted seas and it would require considerable experimentation with land-operated devices and instruction of the pilot for his return trip.

Assuming that the Heaviside layer is a very good or even a perfect reflector, it would be impossible for radio waves to penetrate through this layer from any place out in space. It would likewise be impossible for a person on this earth to keep a telescope trained on an object as small as a rocket, until such time as this rocket reached Mars.

It would be far better to take the trip to the moon first and then return to this earth, than to try one of these long distant shots. The moon is a larger target, it is held within the gravitational pull of this earth and there is a smaller chance that a rocket released from the moon would fail to miss this earth. However, the water area here is so great that a rocket landing in the ocean could have but slight chance of being recovered. Miss Ruth Elder was very fortunate in being rescued.—EDITOR.)

IS MERRITT, BEEBE?

Editor, Science and Invention:

I wish to compliment your company on the magazines it publishes, particularly Amazing Stories and Science and Invention.

I like your series of articles on chemistry, but would like them more technical with more formulas.

I should like to inquire if A. Merritt is the nom de plume of William Beebe. I am convinced it is, having read and compared some books by Beebe with others by Merritt and found the styles uniform, and after allowing for the fact that one was fiction, and the other non-fiction.

I should also like some good books both technical and simple, on hypnotism.

Howard Campaigne,
Chicago, Ill.

(No, Mr. A. Merritt is not the nom de plume of William Beebe. They are separate and distinct individuals.

Unfortunately, we do not know of any good book on hypnotism which gives a modern treatment of the subject. Nearly all of the books on hypnotism are filled with the stage presentation of the subject. They all speak of arm movements and hand movements and inject distorted religious views into the subject. Hypnotism itself is quite simple and it does not require a multiplicity of hand movements. While these startle the audience, they have but little effect on the subject. Hypnotism by the bead method, revolving mirror method and various other ways is seldom explained in any modern publication and certainly is not covered in books of ancient vintage or extraction.—EDITOR.)

THOUGHT TRANSFERENCE

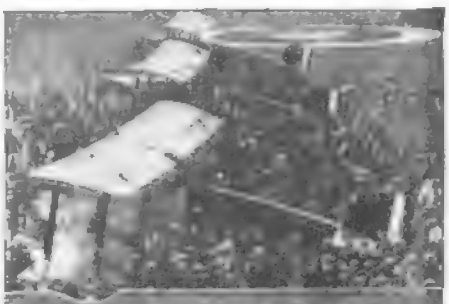
Editor, Science and Invention:

I am writing this in hopes that you will print it in the "Readers' Forum" and I hope that some of your readers will give their views on the matter. Mental telepathy is I think the name of this theory. I have succeeded by years of practice in reading a person's thoughts in various ways. One way is by expressions of the face; every face I see tells me many things. A person has to think before he can act. I can get the nature of the action by a look into the face before the action is carried out. One of the easiest things I find is to tell when a person has a secret on his mind. The fact that he is trying to conceal it, makes it show up to me. Another thing I can do is to say something at the same time another person does and not by coincidence either. I can tell more upon sighting a strange face than upon a friendly one, because I am a stranger and they are unprepared.

Leslie Carpenter,
Burlington, Vt.

(One can frequently see by a person's face and by his action what that person is thinking about. A physician can frequently tell by the lines on a person's face whether the person really has pain or whether he is affecting facial contortion. It requires a great deal of practice and communion with thousands of individuals to do this work consistently.

But it is quite another matter to mention things at the same time another person is thinking of them. We doubt very much if this can be done except coincidentally. Some day have your friends take a deck of cards, shuffle them, pick one out of the deck and think of that card and see if you can do better than 25% correct guesses. The person doing this must not, however, move his lips so as to indicate the nature of the card drawn. This will then constitute a true test of mind reading.—EDITOR.)



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BOOK REVIEW

MODERN ASTRONOMY—ITS RISE AND PROGRESS, by Hector Macpherson, M.A., Ph.D., etc. Stiff cloth covers, 4¾"x7¾", 200 pages. Published by Oxford University Press, New York City. Price $2.00.

It is said that when Sir Isaac Newton came into the world he was so small that he could have been put into a beer-mug. The frontispiece of the book is a beautiful portrait of the great scientist, certainly a very handsome and well developed adult. His treatment of gravitation entitles him to figure at the beginning of so entertaining a work on the latest conclusions of astronomy. The book makes excellent reading and it is interesting to find the Oxford University Press publishing the book in which American astronomers, Pickering and Lowell, for instance, are so appreciatively spoken of. Lowell's work on Mars and Dr. Chapley's work are examples of how the author looks upon the fine work of American astronomers.

CHEMISTRY IN THE WORLD'S WORK, by Harrison E. Howe, stiff cloth covers, 6"x8½", 244 pages. Published by D. Van Nostrand Co., New York City, Price $3.00.

In a clear, non-technical language the author passes rapidly from one subject to another, yet with sufficient detail to enable everyone reading this book to marvel at the advances made in the science of chemistry which are in great part responsible for the attainment of our present level of civilization. The various forms of artificial light and the part chemistry played in making them possible from the crude lamps fashioned from clay to our modern incandescent lights is told so alluringly that even the fiction reader will enjoy it. Many of these small details entirely unknown to the average reader are treated in their proper relations to the rest of the theme. The part chemistry plays in agriculture, cloth and clothing manufacture, decorations, health and sanitation, in natural defense and many other branches are all confined within the pages. The author's purpose that the book may "win a wider circle of friends to the work of the chemist and to secure for him a fuller appreciation," will be served.

In February "Radio News"

The Capitol Family Passes Its Fifth Radio Birthday—By Julia Shawall

The Silver-Marshall Shielded Grid Seven—By McMurdo Silver

The Future of Chain Broadcasting—By Charles Magee Adams

Radio Control Without Wires

Effects of Broadcasting on Religion—By Arthur T. Brown

The Electrified Peridyne—By Hugo Gernsback

What Happens Inside the Shielded-Grid Tube—By R. P. Clarkson

The R.E.L. All-Wave Electric Nine—By R. E. Lacault

POST MORTEM, Book 1, by C. MacLaurin, stiff cloth covers, 5"x7¾", 260 pages. Published by George H. Doran Co., New York City. Price $2.00.

In reviewing this work the writer cannot agree with some other contemporaries who are of the opinion that the proofs expounded are not quite thorough enough. This reviewer's humble opinion is that Dr. MacLaurin has not only based his findings on fact, but he has presented his facts so that there is practically no question as to the truth of the findings. Substantially the book tells how a doctor with his modern scientific education is able to turn back the pages of history and from those pages analyze the particular ailments or diseases of Anne Boleyn, Jeanne D'Arc, Emperor Charles V, Empress Theodora, Don John of Austria, Cervantes, Philip II, Jean Paul Marat, Napoleon I, Benvenuto Cellini, and others. He points out what it was that lay behind the strange hallucinations of the Maid of Orleans. How many know that this girl who had changed history was just an ordinary child when she met her death and was not as stately as some of our pictures would like to have her. How about the peculiar case of Anne Boleyn who was beheaded or rather her husband Henry, the VIII? To say that the book is interesting and fascinating would be putting it mildly.

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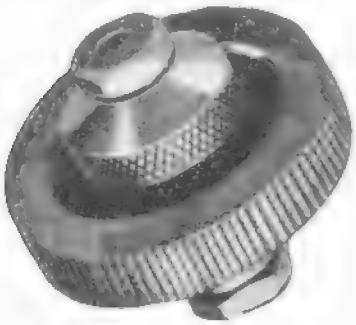

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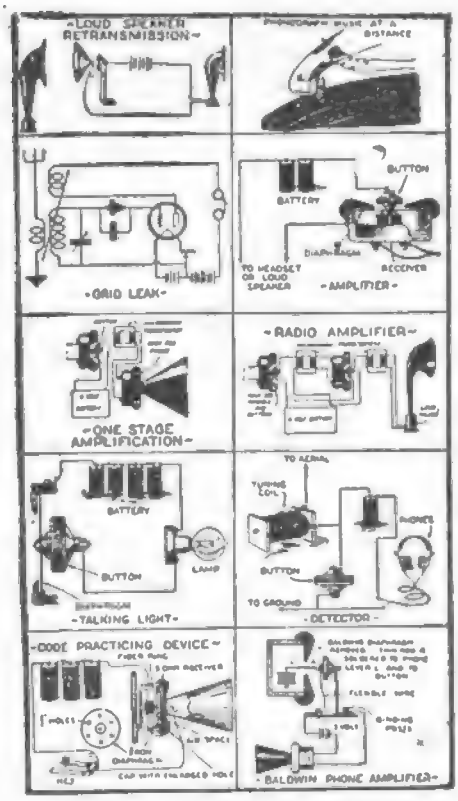

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MECHANICAL APPLIANCES AND NOVELTIES OF CONSTRUCTION, by Gardner D. Hiscox. Sixth revised and enlarged edition. Cloth covers, 6½ by 9¼ inches, 412 pages, profusely illustrated with line drawings. Published by The Norman W. Henley Publishing Co., New York City. Price $4.00.

This new enlarged and revised edition of a very well-known work by Mr. Hiscox is of unqualified value to inventors, engineers, draughtsmen and students of mechanics in general. The work is divided into a number of sections, and each device described is illustrated with clear drawings; where necessary a formula is given, which shows the power relations of the device given. The various sections cover mechanical power levers; the transmission of power; devices used in measuring power; various forms of boilers for steam generation; explosive motor power and appliances; hydraulic power for furnaces; air power motors for furnaces; electric power and devices; navigation and marine appliances; various forms of gearing and gear motion; mill and factory appliances; perpetual motion devices of every description imaginable, and finally a section dealing with radio telegraphic and telephonic apparatus and circuits.

This really remarkable compendium of mechanical devices should be on everyone's bookshelf, for at sometime or other you will find it very valuable indeed. The reviewer has always had a copy of this unusually complete book on mechanical devices in his library, and would not think of being without it.

BOYS BOOK OF EXPERIMENTS, by A. Frederick Collins. Stiff cloth cover, 5½" by 8", 315 pages. Published by Thomas Y. Crowell Co., New York. Price $2.00.

While classified as a boys' book, the experiments in this well assembled collection will appeal to many adults, especially those interested in physics and related sciences. It will prove especially serviceable to High School teachers who wish to stimulate independent work in their pupils. The text carries one forward in several fields of science by a series of simple experiments. Technical language has been avoided as far as possible. The first chapter takes up experimenting with matter, force and time. It gives simple problems dealing with liquids and gases, as well as others relating to time and force. Following this are chapters on machines, showing the principle of wheels, pulleys, etc.; sound, acoustics and reflection and refraction of sound waves. The next chapter takes up heat and devices for testing both cold and heat. Following this are chapters on light, magnetism and electricity. One chapter is devoted entirely to radio, and another one includes chemical experiments. From this brief outline, one can get a fair idea of the practical nature of this book. It will prove valuable as a supplement to classics in physics, chemistry and mathematics.

THE STORY OF CHEMISTRY, by Floyd L. Darrow. 6½ x 9½ inches, 528 pages, cloth covers, profusely illustrated. Published by the Bobbs-Merrill Co., Indianapolis. Price, $4.00.

Now and then comes a book into a reviewer's hands which makes him glad that he has that kind of a job. Such were the feelings after reading Professor Darrow's *"Story of Chemistry."* When we were in college the hours spent in the chemistry classroom and laboratory were not always bright ones, for the simple reason that the men conducting the course failed to give us a background of the work we were supposed to do. We have no doubt that if such a book as this had been given to us before we started the course, we would have gained much more from the hours spent in the "Smell Hole."

Professor Darrow starts his book properly by going back to the days of the Alchemist, and shows how his gropings for the Philosopher's Stone and the Elixir of Life really were the birth throes of chemistry, as we know it today. He then takes his readers through the days when chemistry suffered its growing pains and tells of the various discoveries of Lavoisier, Davy Wohler, Faraday, Liebig, Pasteur, Van't Hoff, and others, and just what these discoveries meant to chemistry.

Then comes a chapter which is really worth the purchase price of the book—that entitled *Atoms, Electrons and Protons.* Down through the various searchings and discoveries of Crookes, Sir J. J. Fleming, Mme. Curie, Prout, Einstein, Langmuir, he unfolds in a clear and intensely interesting manner the story of the make-up of the atom. Electrons and protons are explained in a manner that will appeal to the layman as well as those versed in science, because in this sub-visible universe of whirling worlds, there has been more or less mystery, which is here explained.

The chapter on *Chemistry and Power* contain the most recent findings of chemists, who have devoted years of research to the power supply problems. This phase of chemistry concerns us all, as it deals with the dwindling supply of coal, and oil, and how the chemist is attacking the problem of giving us the wherewithal to travel about without using our legs.

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the contents, we may say, is of interest to everyone, for are we not all dependent to the greatest extent possible on the work of the chemist? These headings are *Agriculture and War; Chemistry and Disease; Rubber; Gases;* the *Age of Metals;* the *Twilight Realm of Matter,* dealing with colloids; *Synthetic Chemistry; American Progress in Chemistry,* and *Research, the Key to Future Progress.*

The entire book is up to the very last minute, as facts which occurred in the spring of 1927 are recorded. The average layman need not be afraid of this work, as it is written in simple, understandable English and gives the reader credit for having some intelligence, even though there are completely lacking all chemical formulae, mathematical equations, etc., which are the bane of the ordinary lay reader. In short, if you would like to get a good knowledge of what has been done in chemistry and would like your knowledge in sugar-coated doses, read Professor Darrow's book.—G. C. B. R.

THE MOTORCAR AND ITS STORY, by Charles R. Gibson, F.R.S.E. Illustrated, 186 pages, 8 x 5½ inches, stiff cloth covers. Published by J. B. Lippincott Co., Philadelphia.

In the present day, when we think nothing more of seeing an airplane flying about over our heads than we do of seeing a man walking down a street, it is sometimes rather difficult to think back to the beginning of the nineteenth century, when "horseless carriages" were under experimentation. The automobile is such a common thing today, that we are apt to lose sight of the fact that it went through a period of evolution, just as flying machines are doing today.

In *The Motorcar and Its Story* the author sketches in a brief manner how some of the first "horseless carriages" operated and how they came to be developed. Before the internal combustion motor was thought of most of these forerunners of the automobile were run by steam, and even after Otto had developed a gas engine and it had been applied to operating vehicles, steam was used on automobiles. Most of these early cars ran on an average of 4 to 7 miles per hour. In the Paris-Rouen race in 1894 the winner, a Panhard, averaged 12 miles per hour, and it was not until 1901 that a 60 h.p. Panhard averaged 54 m.p.h. in the Paris-Bordeaux race.

The author attributes the backward condition of the early automobile in England to the laws, which prohibited horseless carriages in certain districts from going faster than a man could walk. In fact, it was required by law to have a man to walk in front of the car carrying a red flag in his hand and warning people that an automobile was coming. No such laws were in force on the Continent, and so the automobile industry developed faster there than it did on the British Isles.

Certain portions of the book are interesting from an historical viewpoint, but the contents are, in general, of greater interest to those living in Great Britain than in the United States, as mention is made almost entirely of cars built in that country and which are not generally known over here. Quite a good-sized portion of the book is devoted to the methods of building cars, the theory of propulsion, energy and electrical equipment on cars. These latter subjects are rather sketchy, in that sufficient space has not been devoted to them.—G. C. B. R.

ESSAYS IN POPULAR SCIENCE, by Julian Huxley. Stiff cloth covers, 6 x 9 inches, 316 pages, illustrated. Published by Alfred A. Knopf, Inc., New York City. Price, $4.00.

The aim of this book is to arouse public interest in biology and to maintain it. The author points out that unless the civilized societies of today improve their organization and enforce adequate measures for regulating human reproduction, and at least prevent the deterioration of the quality of the racial stock, they are doomed to decay and to be submerged in some barbarian flood. In order to achieve this, man must at least consent to think scientifically about himself and the intimate facts about his life, instead of surrounding every vital problem with prejudice. In this task, biology must be his chief servant, and it is with this aim in view that the author has devoted chapters to the control of the live stock, heredity, the inheritance of acquired characteristics and the like. It is evident that after reading this book, the layman will have unconsciously acquired a new outlook on life and also an interest in biology, which if ever present, was practically buried and forgotten.

PLANETEN UND MENSCHEN, by Dr. H. Dekker. Stiff cloth covers, 5¼" x 7¾", 92 pages, illustrated. Published by Kosmos, Stuttgart, Germany.

This is one of the very attractive little handbooks published by Kosmos of Stuttgart. It is a curious mixture of ethnology and astronomy. It treats on the subject of life on Mars, for instance, taking the ground that while this planet may have had inhabitants in the past, it is barren of life now. Of course Dr. Lowell's canals have to figure, and in a way it may be said that it would take a German to produce so readable a book covering the great world or "kosmos," and the little world, the microkosmos, or man. The book will repay careful study.

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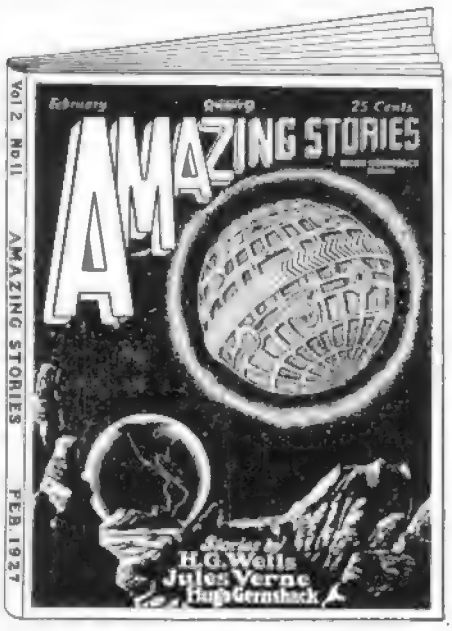

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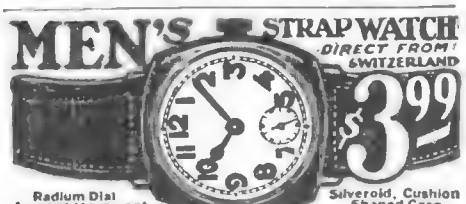

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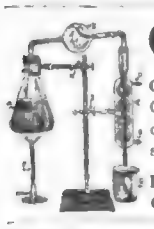

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BALLOON AND AIRSHIP GASES, by Charles deForest Chandler and Walter S. Diehl. Stiff cloth covers, 6 x 8½ inches, 226 pages, profusely illustrated. Published by The Ronald Press Co., New York City. Price, $4.00.

This book, which is but one of the volumes in the Ronald Aeronautic Library, is divided into two main parts. The first part describes the production processes used for hydrogen and helium and the compression and storage of gases, and is written by Charles deForest Chandler. The second part, describing the physics of gases, is by Walter S. Diehl. The subject matter is intended to supply information for military and commercial manufacturers engaged in producing balloon gases. The first part, while it deals with helium, gives a general description of the equipment with the method of production. The physical formulas needed in gas computations are given in the second part, as well as many physical tables which should prove useful to research engineers. The text is so arranged that the book may be admirably used as a reference handbook or as a textbook in aeronautical schools. Those engaged in aeronautics of the "lighter than air" type will find much of interest in this volume.

PRESSURE AIRSHIPS, by Thomas L. Blakemore, S.B., M.S.A.E., and W. Watters Pagon, A.B., S.B., M.C.E. Stiff cloth covers, size 6 x 8½ inches, 312 pages, numerous illustrations. Published by The Ronald Press Co., New York City. Price $8.00.

This volume is divided into two parts; part one, written by Thomas L. Blakemore, deals with nonrigid airships, and part two contains a description of the semi-rigid types, by W. Watters Pagon. The volume is a result of the experience gained by the authors in the U. S. Army and Navy, both during and since the World War. However, the text is not limited to American practices alone, various European sources of information have been drawn upon freely, especially regarding the semi-rigid types. The book will be found useful and interesting by students, aeronautical engineers, designers, and others interested in pressure airships, in which the gas acts as a stiffening factor.

THE GIST OF EVOLUTION, by Horatio Hackett Newman, Ph.D. Stiff cloth covers, 5¼ x 7¾ inches, 154 pages. Published by The Macmillan Co., New York City. Price, $1.50.

The author, in writing this book, shows that one can believe in God and in religion and can be a good Christian as well as an evolutionist. The work has been written in a clear and concise manner, with a view toward reconciling evolution and religion, as well as giving to the layman a comprehensive and condensed treatise on this much discussed subject. Numerous proofs and evidences of evolution are set forth so that the reader will obtain a clear outlook on evolution and glean much information and interesting facts concerning it.

KLEINE ELEKTROTECHNIK FUR JUNGEN, by Hanns Gunther. Stiff cloth covers, 5¼" x 7¾", illustrated, 254 pages. Published by Franckh'sche Verlagshandlung, Stuttgart, Germany.

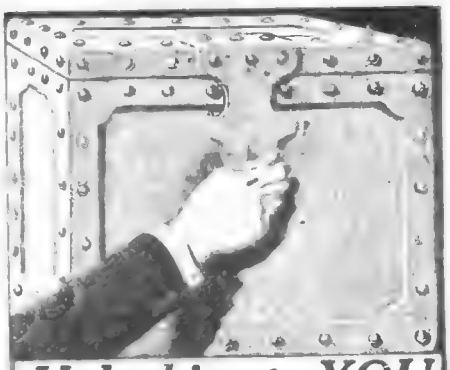
Again we find one whom we may say is Childhood's Friend, Hanns Gunther, really Dr. W. De Haas, telling all about electricity for the benefit of the young. The book is very attractively illustrated with a sort of free hand effect and constant regard is kept to the fact that it is designed for children. Simple battery constructions using electric light carbon as the case may be, then going on the batteries using plate and all quite suggestive and naturally enough all the more or less old fashioned types of batteries are given.

VOM SANDKORN ZUM KRISTALLGEFASS, by C. J. Stahl. Stiff cloth covers, 5¼" x 7¾", illustrated, 76 pages. Published by Dieck & Co., Stuttgart, Germany.

This interesting little book traces the path of silica from the sand bank to the glass works where made into a suitable "batch" with lime and soda or potash as the case may be it is melted down to the beautiful transparent glass which really should always be an object of admiration. Considering that the scientific mind that outgrows the faculty of being surprised at the most every day achievement of the mechanical arts is taking a back step, an enormous sheet of plate glass such as we see in the store windows absolutely transparent without the suggestion of tint of color about it is a true miracle of technology. One feels in looking at this little manual that the pity is that it is not longer.

LES LAMPES, A PLUSIEURS ELECTRODES ET LEURS APPLICATIONS. Stiff cloth covers, 6¼" x 10", 326 pages, illustrated. Published by Etienne Chiron, Paris, France.

This book is a translation into French from the Polish. A few words of introduction by



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Professor Pozaryski says that in Poland where the Radio industry is starting the scientists were about to avail themselves of all that other peoples had accomplished up to date. The present book uses the mathematical developments of the subject to the fullest extent, giving numerous equations in calculus, so that to really get the good out of it, one must be a finished mathematician. It has numerous illustrations in the shape of diagrams and a very full set of biographies are given as an appendix and a full table of contents may be supposed to take the place of an index. When we consider that there are very nearly 150 conventional signs given in a preliminary list the extent of the book may be imagined.

PREHISTORIC MAN, by Keith Henderson. Stiff cloth covers, 6 x 8 inches, 272 pages, 102 illustrations. Published by E. P. Dutton & Co., New York City. Price, $3.00.

In a vivid and picturesque style, the author tells the story of man's ascent through the prehistoric ages. Nothing more fascinating or interesting has been written about the cave dwellers, the beginnings of tribal customs, dress, and beliefs. The text is further enriched by a number of unusual illustrations. As one turns the pages he takes a delightful educational journey into man's prehistoric past. The book is thoroughly informative without being too technical, and is of ready reference for popular education, as well as of genuine literary worth.

NEW METHODS IN GEOMETRICAL OPTICS, by Charles S. Hastings, stiff cloth covers, 5½"x8", 103 pages, published by the Macmillan Co., New York City. Price $2.00.

The text, which is a physical work, replaces the data ordinarily employed in calculating optical systems by real entities, such as, wave surfaces, wave velocities, and surface curvatures. The designer of an optical system often lacks a means whereby errors in color correction, or any zonal difference of focal distance may be corrected. In this book the fundamental equations of optics have been replaced by quantities which can be defined either in place or in time. Thus the fundamental equations are greatly simplified, their derivatives are easily found, and the labor required in designing a lens system is reduced considerably. In this book a new method in optics is presented, with special attention given to the design of centered optical systems. The advantages accompanying the use of readily deduced derivative equations are clear to the mathematician and should certainly recommend themselves in actual practice.

ISOSTASY, by William Bowie, stiff cloth covers, 5¾"x8¼", 275 pages, illustrated, published by E. P. Dutton & Co., New York City. Price $5.00.

In writing this book the author has considered the two views on Isostasy. One holds that the earth's crust extends to a certain depth below sea level, and the other, that crustal matter has uniform density with varying thickness. The writer is convinced from his studies that the former theory is the more logical. The Pratt theory is used in applying isostasy to the consideration of the earth's crust and the processes which cause horizontal and vertical movements on the surface. The great mass of literature dealing with isostasy is enormous, and has been presented in a comprehensive form in this text. The book should be exceedingly valuable to petroleum and mining engineers, professors of geology, and students who are interested in this subject.

THE ROMANCE OF THE ATOM, by Benjamin Harrow, stiff cloth covers, 5¼"x 7¾", 162 pages, published by Boni & Liveright, New York City. Price $1.50.

This book describes in non-technical language the achievements of chemists and physicists in solving some of the deep mysteries which are hidden within the atom. Much of the mystery within us and surrounding us can be explained with the help of these atoms. The text deals mainly with the atomic inner structure, tracing the story from the time of alchemy up to the present day. The concluding chapters in the book deal with the origin of life, and the application of science to our present every day existence.

THE STORY OF THE ATOM, by W. F. F. Shearcroft, stiff cloth covers, 5"x 7½", 77 pages, published by Greenberg, Publishers, New York City. Price $1.25.

The story of the atom has been written from the popular standpoint, and is an exposition of this fascinating subject for the non-technical reader. The book is plainly written and will be read with pleasure and profit by the layman. The atomic theory, the molecule, radio activity, and disintegration are explained in simple language devoid of all technicalities. The book is but one of a science series written in popular style for a non-technical public.

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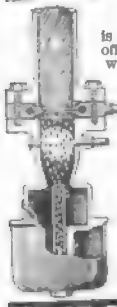

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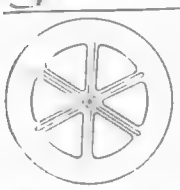

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VOLT-AMMETER

Above is a view of a new combination volt and ammeter which has recently been developed. The instrument has four terminals, two at the bottom and two at the top, which enable it to be connected as a voltmeter or ammeter. An adjusting knob is placed on top of the meter in order to correct any inaccuracies of the pointer.

—Photo Courtesy Roller-Smith Co.

NEW ORANGE SQUEEZER

Above is a new orange or lemon squeezer which was recently shown at the Annual Food Show in Los Angeles. The device is cranked by hand and is said to be extremely efficient. The receptacle for the oranges is made of white china, and the squeezer is mounted upon a metal base.

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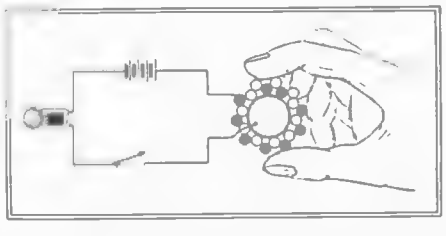

A new kind of electric cable for carrying small currents has recently been invented in Berlin. It is a system of wires woven in a loose braid and is separated by an elastic non-conductor, which permits a contact to be made at any point, merely by pinching the cable. This invention abolishes the necessity of push-buttons at set points.

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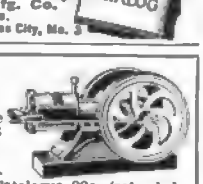

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Home Broadcasting—A New Pleasure

(*Continued from page 917*)

is to be shown to its best advantage. If an artist learns to vary the distance between himself and the microphone, or inclines the head slightly out of line, there will be no blasting on the phrases which are to be stressed. This, of course, is taken care of at the present time by the operator at the control board of the transmitter; but unless he is familiar with the music to be sung or played, there will be some blasting. Now, however, with the aid of this device, the home critic can advise the performer.

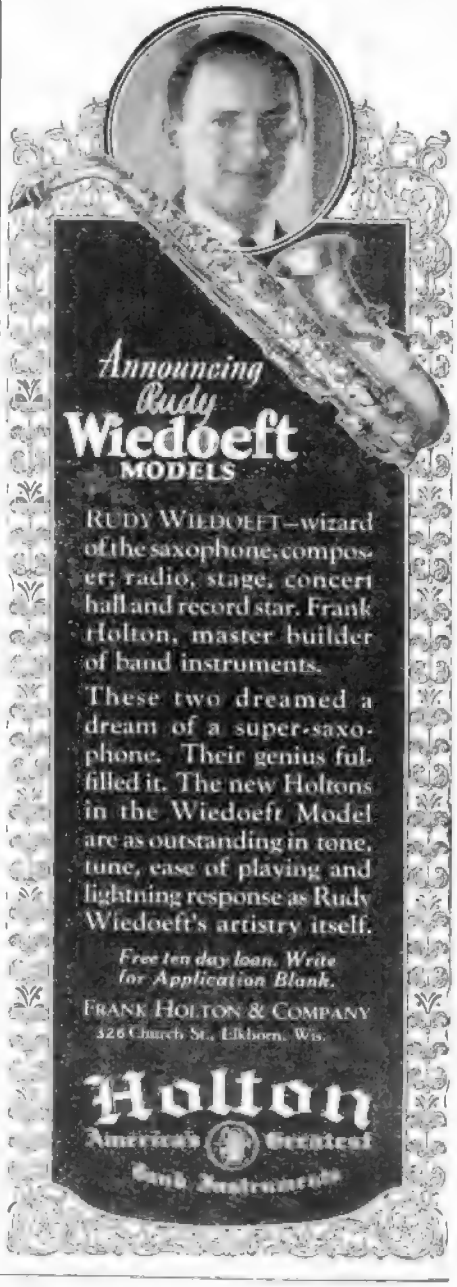
Imagine the amazement when one walks into the room, in which is placed an ordinary broadcast receiver reproducing with utmost fidelity the strains of a dance number which the announcer says *is coming from station 2LO, London, England*. A very clever stunt is that of cutting the microphone into the circuit an instant before a regular broadcasting station is to make its announcement. A suitable announcement can thus be made before the regular announcement and the switch thrown, again cutting in the regular radio broadcasting station.

By a strange twist, this instrument permits reversing, that is, if there is a conversation in the room in which the radio receiver is placed, the speaker of the set will pick up and transfer this speech to the room where the "broadcaster" is located. Numerous possibilities are thus suggested to the "broadcaster." Numbers can be requested to be played by the radio receiver and the astounding part of it all is that the receiver will usually comply with the request. The home broadcaster is again at the bottom of this trickery and either sings into the microphone or plays the selection upon a phonograph in some distant room. With this device the home broadcaster should have no difficulty in fooling his friends during a pleasant evening of varied amusement. Another novel experiment is using the device to reproduce telephone conversations over the loud speaker of the radio set. A switch is used to cut the speaker in or out of the circuit, as the case may be.

The device besides proving to be an amusement in the home should also be a great help to those having youngsters. In order to get them to bed early, or behave properly, the broadcaster can adjoin to an adjacent room and imitate the Sandman, Santa Claus and any other fairy tale character which may have impressed itself upon the juvenile mind.

The broadcasting unit may also serve practically in the business world by using it for inter-departmental communication, whereby the head of a firm will be able to talk to any one of his subordinates. This would necessitate, however, the use of a switching system which would cut in on the particular line wanted. Engineers who are now working on this idea say that the main difficulties have been overcome and that it will soon be put to use in this manner.

The simple device which will supply all of the pleasure and entertainment as outlined, is not costly and consists of an adapter which is plugged into the detector socket, with a switch to cut the microphone in or out of the circuit. The signal is amplified by the audio system employed in the radio receiver, and is then reproduced by the loudspeaker. There are no external connections to be made to the home broadcasting outfit, and its installation and operation are extremely simple.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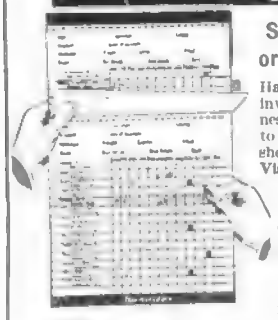

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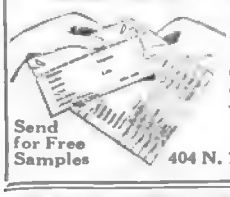

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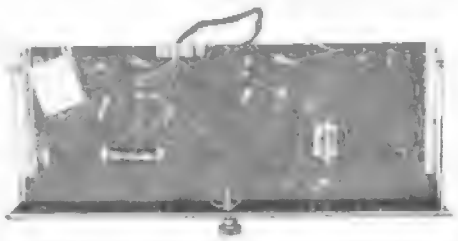
S. & I. 3-Tube A.C.-D.C. Set

By PAUL WELKER

(*Continued from page 919*)

OPERATION OF THE RECEIVER

This three-tube set is simple and flexible in operation, most of the tuning being done with the variable condenser. Regeneration is controlled by the small knob on the left hand side of the panel, which regulates the position of the tickler in the small three-circuit tuner. The set will be found to deliver excellent volume, in fact, it may even be too loud for a small room when a power tube is employed. In view of this fact, a variable resistance has been placed across the secondary of the last A.F. transformer. This serves as a volume control and will be found necessary if a power tube is used in the last stage. Even in congested districts, the receiver will tune sharply enough so that no more than one station is received at a time. The set as it stands on this page has been built for storage battery operation, but can be easily changed over so that the new A.C. tubes may be employed. Those who do not wish to make an A.C. operated set at the present time may find it advisable to build this receiver and then change it over at a later date, according to the instructions which will be published in the next issue of this magazine. With three-tube A.C. set it is not necessary to use an outside antenna, as the electric light line is used for the aerial. Thus we have an ideal set which is simple in operation, economical in current consumption and of great appeal to the apartment house dweller.



The above photograph shows a bottom view of the set. The placement of the cable and speaker filter condenser may be seen.

LIST OF PARTS

1 small three-circuit tuner.
1 .0005-mf. variable condenser.
1 .00025-mf. grid condenser, with grid leak clips.
1 .001-mf. fixed condenser.
1 2-mf. speaker filter condenser.
3 cushion sockets.
1 filament switch.
1 ¾-ampere filament ballast.
2 low-ratio audio-frequency transformers.
1 output transformer or output impedance.
1 0 to 500,000-ohm volume control.
1 7-wire battery cable.
1 7" x 18" hard rubber, bakelite or celoron front panel.
1 7" x 16" hard rubber, bakelite or celoron sub-panel.
2 sub-panel mounting brackets.
1 midget jack.
Necessary hook-up wires, screws, lugs, etc.

Names of manufacturers of parts used in the construction of this receiver will be furnished free upon request.

TOOL LIST

Pliers, several kinds.
Screw-drivers, several sizes.
Hammer, hacksaw and blades.
Hand drill.
Twist drills, several sizes.
Scriber.
Center-punch.
Soldering iron, electric or other type.
Wire solder, self-fluxing or plain solder and non-corrosive flux.

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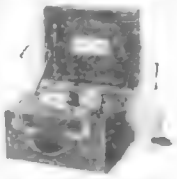

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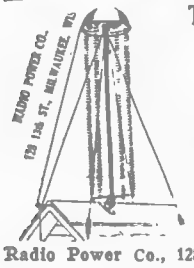

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Radio Wrinkles

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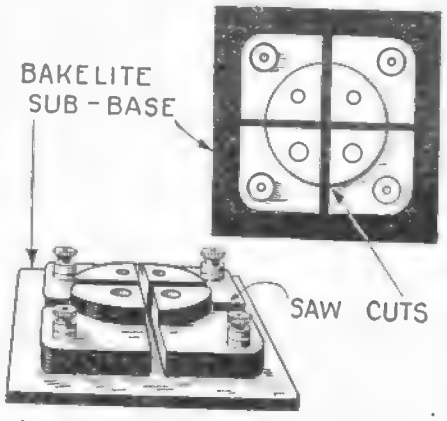
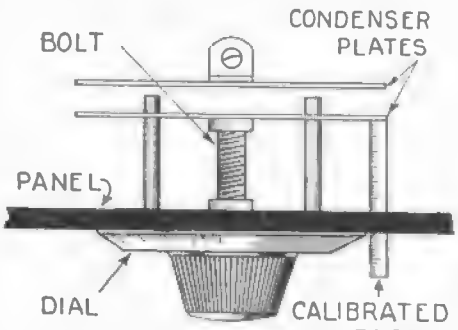
LOW LOSS SOCKET



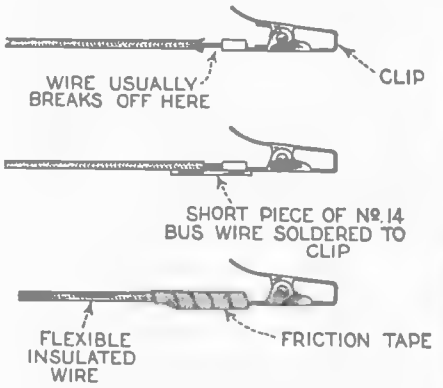
A very good low loss socket can be made by taking an ordinary one and screwing it to a square piece of bakelite or hard rubber by means of small screws. The socket is then cut in quarters by means of a hack-saw. This socket will be found to be quite an improvement when used on very short wavelengths, as losses are cut down to a minimum. If the saw cuts are too wide, care should be taken so that the tube is inserted the right way.
J. C. F. Walton, Rep. No. 23,087.

SHORT-WAVE CONDENSER



An ultra short wave condenser can be made from two circular plates which are assembled as shown in the above illustration. The stationary plate is mounted on the sub-panel or baseboard. A calibrated peg is affixed to the movable plate and projects through the panel. Thus very fine readings can be taken. The capacity of this condenser may be raised by putting some sheets of mica between the plates. The dial readings will be more complicated, but greater accuracy will be obtained.—Joseph L. Johnson.

PREVENTING WIRE BREAKAGE



The wire soldered to test clips usually breaks off at the point shown in the above diagram. This may be prevented by soldering a short piece of bus bar wire to the under side of the clip. The wire is then tightly wrapped with friction tape, which helps to keep the insulation from fraying and also provides a better grip.—D. S. Jenkins.

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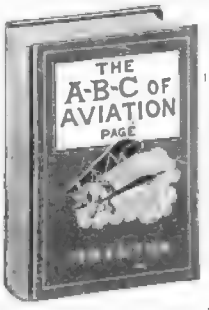

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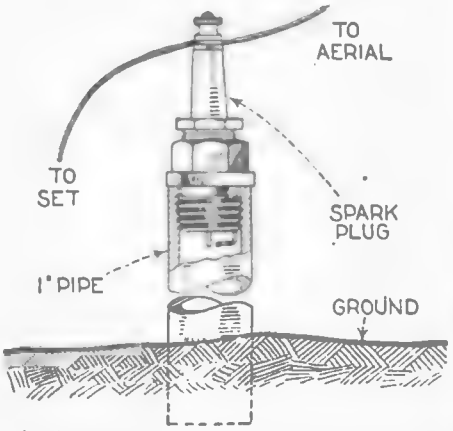
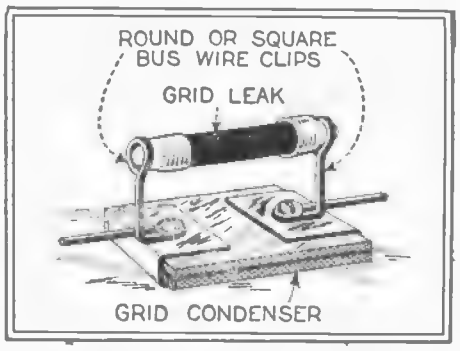


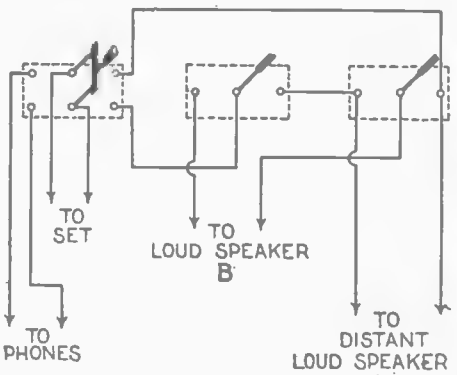
At the expense of about a dollar, a very neat and efficient lightning arrestor may be constructed. A spark plug is screwed into the end of a length of 1-inch pipe which has been driven into the ground as an earth connection.—D. Borowitz. Rep. No. 24259

GRID LEAK CLIP



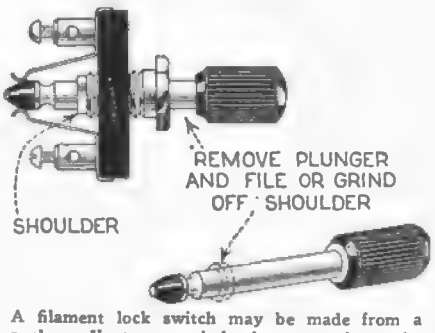
The average grid leak is mounted in parallel to the grid condenser, hence it is often desirable to extend the leads to form clips as shown above.

LOUD-TALKER SWITCHES



Two S.P.D.T. switches and one D.P.D.T. switch may be combined to vary the connections to a series of loud-talkers at different points.—J. R. Meager.

LOCKING BATTERY SWITCH



A filament lock switch may be made from a push pull type switch by removing the plunger and filing off the shoulder. This makes it possible for the plunger to be entirely removed from the switch thus opening the circuit.—D. S. Jenkins.

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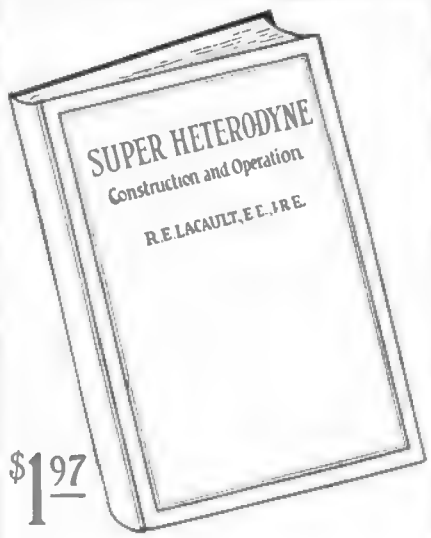

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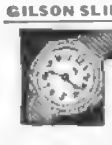

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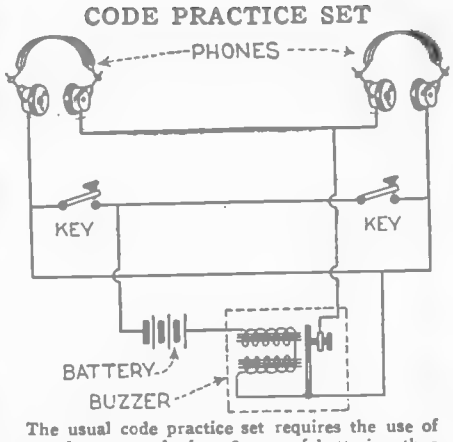
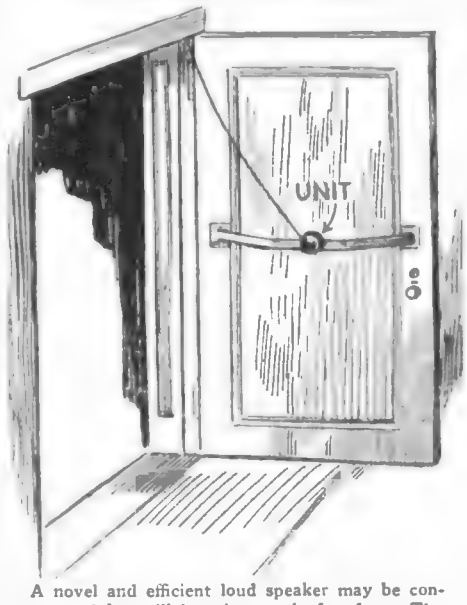


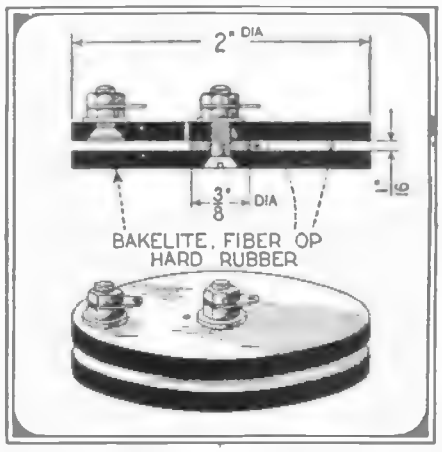
The usual code practice set requires the use of two buzzers and often 2 sets of batteries, thus making the assembly rather expensive. Using the arrangement shown above, 1 buzzer and 1 battery may be used to take the place of a larger number regardless of the number of head sets and keys in use.—R L. Pepperberg. Rep. No. 20490.

DOOR LOUD SPEAKER



A novel and efficient loud speaker may be constructed by utilizing the panel of a door. The unit is mounted on one side of the door and clamped securely in position. The two leads should be allowed enough play so that the door may be opened and shut easily. This type of speaker gives excellent reproduction and the volume is good.—James Francis Clemenger.

RADIO FREQUENCY CHOKE



The idea illustrated above gives a method for constructing radio frequency choke coils at a minimum of time and expense. Two disks of bakelite, fibre or hard rubber 2 inches in diameter are bolted together. The wire is wound between these disks making a very neat job. Connections may be made as shown or the constructor may use his own ingenuity.

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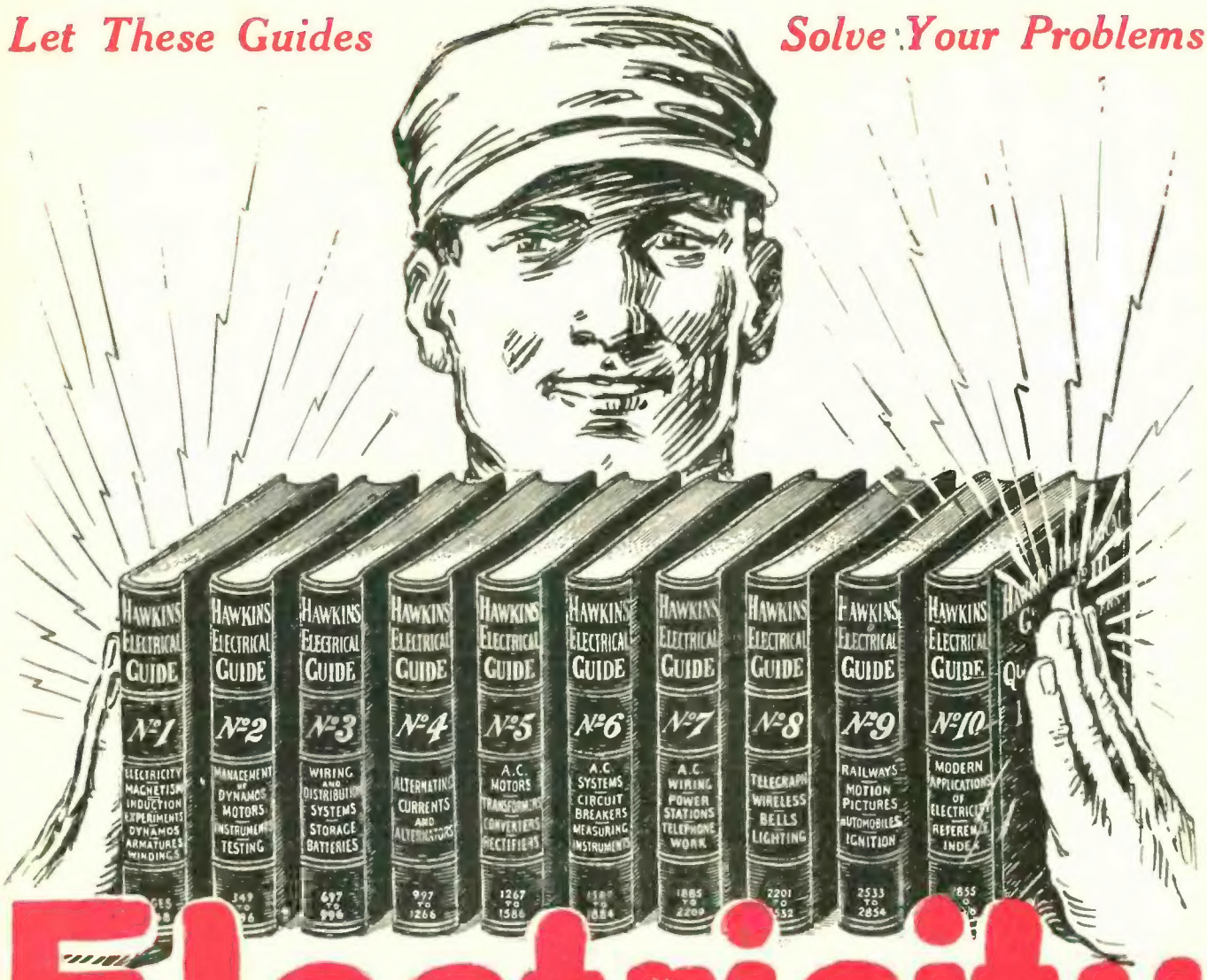

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